



# APPLIED MATHEMATICS 10–20–30


## Program of Studies

**Alberta**  
EDUCATION

Curriculum Standards Branch

CURRGDHT Interim 1998

QA  
14  
C2  
A738  
1998  
gr.10-12



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# APPLIED MATHEMATICS 10–20–30

## A. PROGRAM RATIONALE AND PHILOSOPHY

Applied mathematics gives students a clearer picture of why they are learning the mathematics and motivates them in learning. Students experience mathematics as being dynamic and useful in their careers and everyday life.

The approach used in applied mathematics is primarily data driven, using numerical and geometrical problem-solving techniques. As a way of increasing relevance, students collect data in experiments and activities and develop mathematics concepts from analyses of the data. Algebraic constructs are addressed as a result of activities that students do or as a result of experiences that they are engaged in.

Applied mathematics students are required to demonstrate effective communication skills. This includes understanding, using, and interpreting various media types. Students are expected to make efficient use of both oral and written communication.

When accomplishing program or curriculum outcomes, students come to understand that mathematics is much more than theory emphasizing a set of algorithms. They learn that mathematics is a powerful set of processes, models and skills that can be used to solve nonroutine problems, both in and out of the classroom.

Applied mathematics tasks are designed to develop student flexibility and responsibility. Students show flexibility by working individually and in cooperative groups and working on nonroutine problems and projects. Students show responsibility as they work independently and explore connections among other mathematical areas, other school subjects and real-life applications. Students need support in developing flexibility and responsibility.

Technology is an integral part of applied mathematics. The graphing calculator is the primary technological tool used by students for mathematical exploration, modelling and problem solving. The use of spreadsheets, with functions defined by the student, is expected in all contexts. Technology is an effective and integral part of learning and assessment, both formative and summative, in applied mathematics.

The Applied Mathematics 10–20–30 program is made up of outcomes, some of which are common to both the applied and pure mathematics programs. The approach to the common outcomes varies from the applied to the pure programs, but the critical skill of using mathematics to find solutions to real-life situations is developed in both programs.

## B. LEARNER OUTCOMES

The general outcomes for the complete Applied Mathematics 10–20–30 program are shown first. For each of the three courses, the learner outcomes follow the format of general outcome, specific outcomes and illustrative examples. The illustrative examples are for discretionary use only. The outcomes are arranged in order of strand and substrand, following the order—Number, Patterns and Relations, Shape and Space, Statistics and Probability—established in the Grade 10 to Grade 12 common curriculum framework. This listing is not intended as a sequence for instruction, and the number of outcomes is not an indication of the relative times to be spent on each of the strands. Specific outcomes with a C prefix, such as C1–2, refer to those outcomes that form part of the common core, while specific outcomes with an A prefix, such as A2–4, refer to those outcomes that are exclusive to applied mathematics.

## GENERAL OUTCOMES—Number Strand

Substrand	Applied Mathematics 10–20–30
<p><b>Number Concepts</b>  <i>Students will:</i></p> <ul style="list-style-type: none"> <li>• use numbers to describe quantities</li> <li>• represent numbers in multiple ways.</li> </ul>	<p>Analyze the numerical data in a table for trends, patterns and interrelationships. [Applied Mathematics 10]</p> <p>Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system. [Applied Mathematics 10]</p>
<p><b>Number Operations</b>  <i>Students will:</i></p> <ul style="list-style-type: none"> <li>• demonstrate an understanding of and proficiency with calculations</li> <li>• decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.</li> </ul>	<p>Use basic arithmetic operations on real numbers to solve problems. [Applied Mathematics 10]</p> <p>Describe and apply arithmetic operations on tables to solve problems, using technology as required. [Applied Mathematics 10]</p> <p>Solve consumer problems, using arithmetic operations. [Applied Mathematics 20]</p> <p>Describe and apply operations on matrices to solve problems, using technology as required. [Applied Mathematics 30]</p> <p>Design or use a spreadsheet to make and justify financial decisions. [Applied Mathematics 30]</p>



## GENERAL OUTCOMES—Patterns and Relations Strand

Substrand	Applied Mathematics 10–20–30
<p><b>Patterns</b>  <i>Students will:</i></p> <ul style="list-style-type: none"> <li>use patterns to describe the world and to solve problems.</li> </ul>	<p>Generate and analyze cyclic, recursive and fractal patterns.          [Applied Mathematics 30]</p>
<p><b>Variables and Equations</b>  <i>Students will:</i></p> <ul style="list-style-type: none"> <li>represent algebraic expressions in multiple ways.</li> </ul>	<p>Represent and analyze situations that involve expressions, equations and inequalities. [Applied Mathematics 20]</p> <p>Use linear programming to solve optimization problems.          [Applied Mathematics 20]</p>
<p><b>Relations and Functions</b>  <i>Students will:</i></p> <ul style="list-style-type: none"> <li>use algebraic and graphical models to generalize patterns, make predictions and solve problems.</li> </ul>	<p>Examine the nature of relations with an emphasis on functions.          [Applied Mathematics 10]</p> <p>Represent data, using linear function models.          [Applied Mathematics 10]</p> <p>Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate. [Applied Mathematics 20]</p>



## GENERAL OUTCOMES—Shape and Space Strand

Substrand	Applied Mathematics 10–20–30
<p><b>Measurement</b>  <i>Students will:</i></p> <ul style="list-style-type: none"> <li>describe and compare everyday phenomena, using either direct or indirect measurement.</li> </ul>	<p>Demonstrate an understanding of scale factors, and their interrelationship with the dimensions of similar shapes and objects. [Applied Mathematics 10 and 20]</p> <p>Solve problems involving triangles, including those found in 3-D and 2-D applications. [Applied Mathematics 10]</p> <p>Use measuring devices to make estimates and to perform calculations in solving problems. [Applied Mathematics 10 and 20]</p> <p>Analyze objects, shapes and processes to solve cost and design problems. [Applied Mathematics 30]</p>
<p><b>3-D Objects and 2-D Shapes</b>  <i>Students will:</i></p> <ul style="list-style-type: none"> <li>describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.</li> </ul>	<p>Solve coordinate geometry problems involving lines and line segments. [Applied Mathematics 10]</p> <p>Develop and apply the geometric properties of circles and polygons to solve problems. [Applied Mathematics 20]</p> <p>Solve problems involving polygons and vectors, including both 3-D and 2-D applications. [Applied Mathematics 30]</p>

## GENERAL OUTCOMES—Statistics and Probability Strand

Substrand	Applied Mathematics 10–20–30
<p><b>Data Analysis</b>  <i>Students will:</i></p> <ul style="list-style-type: none"> <li>collect, display and analyze data to make predictions about a population.</li> </ul>	<p>Implement and analyze sampling procedures, and draw appropriate inferences from the data collected. [Applied Mathematics 10]</p> <p>Apply line-fitting and correlation techniques to analyze experimental results. [Applied Mathematics 10]</p> <p>Analyze graphs or charts of given situations to derive specific information. [Applied Mathematics 20]</p>
<p><b>Chance and Uncertainty</b>  <i>Students will:</i></p> <ul style="list-style-type: none"> <li>use experimental or theoretical probability to represent and solve problems involving uncertainty.</li> </ul>	<p>Use normal and binomial probability distributions to solve problems involving uncertainty. [Applied Mathematics 30]</p> <p>Solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations. [Applied Mathematics 30]</p> <p>Model the probability of a compound event, and solve problems based on the combining of simpler probabilities. [Applied Mathematics 30]</p>

# APPLIED MATHEMATICS 10

**Strand:** Number (Number Concepts)

*Students will:*

- use numbers to describe quantities
- represent numbers in multiple ways.

[C] Communication

[CN] Connections

[E] Estimation and  
Mental Mathematics

[PS] Problem Solving

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[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]																																																																																		
<p><b>General Outcome</b></p> <p>Analyze the numerical data in a table for trends, patterns and interrelationships.</p> <p><b>Specific Outcomes</b></p> <p>C1–1. Use words and algebraic expressions to describe the data and the interrelationships in a table with rows that are not related recursively (not calculated from previous data). [C, CN]</p>	<p>1.1</p> <table><tr><th>Price</th><th>GST</th><th>PST</th><th>Total</th></tr><tr><td>\$120.00</td><td>\$ 8.40</td><td>\$12.84</td><td>\$141.24</td></tr><tr><td>\$275.00</td><td>\$19.25</td><td>\$29.43</td><td>\$323.68</td></tr></table> <p>a) What is the rate of GST? b) What could be the rate of PST? c) What could be the rule for calculating PST? d) What is the total GST paid on the two items in the table? e) What is the total PST paid on the two items in the table?</p> <p>1.2 National Hockey League (NHL) Western Conference: February 1, 1996</p> <table><tr><th></th><th>W</th><th>L</th><th>T</th><th>Points</th></tr><tr><td>Detroit</td><td>35</td><td>9</td><td>4</td><td>74</td></tr><tr><td>Colorado</td><td>26</td><td>14</td><td>9</td><td>61</td></tr><tr><td>Chicago</td><td>25</td><td>15</td><td>11</td><td>61</td></tr><tr><td>Toronto</td><td>22</td><td>19</td><td>9</td><td>53</td></tr><tr><td>St. Louis</td><td>21</td><td>20</td><td>8</td><td>50</td></tr><tr><td>Winnipeg</td><td>21</td><td>24</td><td>4</td><td>46</td></tr><tr><td>Vancouver</td><td>17</td><td>20</td><td>12</td><td>46</td></tr><tr><td>Los Angeles</td><td>17</td><td>22</td><td>11</td><td>45</td></tr><tr><td>Calgary</td><td>18</td><td>23</td><td>9</td><td>45</td></tr><tr><td>Edmonton</td><td>18</td><td>25</td><td>6</td><td>42</td></tr><tr><td>Anaheim</td><td>17</td><td>27</td><td>5</td><td>39</td></tr><tr><td>Dallas</td><td>14</td><td>24</td><td>10</td><td>38</td></tr><tr><td>San Jose</td><td>11</td><td>35</td><td>4</td><td>26</td></tr></table> <p>What happens to the NHL standings if wins are worth three points and ties are worth one point?</p>	Price	GST	PST	Total	\$120.00	\$ 8.40	\$12.84	\$141.24	\$275.00	\$19.25	\$29.43	\$323.68		W	L	T	Points	Detroit	35	9	4	74	Colorado	26	14	9	61	Chicago	25	15	11	61	Toronto	22	19	9	53	St. Louis	21	20	8	50	Winnipeg	21	24	4	46	Vancouver	17	20	12	46	Los Angeles	17	22	11	45	Calgary	18	23	9	45	Edmonton	18	25	6	42	Anaheim	17	27	5	39	Dallas	14	24	10	38	San Jose	11	35	4	26
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C1–2. Use words and algebraic expressions to describe the data and the interrelationships in a table with rows that are related recursively (calculated from previous data). [C, CN]	<div>2.1 The following table provides data on the repayment of a \$100 000 farm loan. The farmer has negotiated for one annual payment to be made each year after harvest and for the right to make an extra payment, if the harvest is good. Use the table to answer the questions.</div> <table><tr><th>Year</th><th>Opening Balance</th><th>Interest Rate (%)</th><th>Interest Charged</th><th>Regular Payment</th><th>Extra Payment</th><th>Closing Balance</th></tr><tr><td>1</td><td>\$100 000.00</td><td>8</td><td>\$8000.00</td><td>\$14 902.95</td><td></td><td>\$93 097.05</td></tr><tr><td>2</td><td>\$ 93 097.05</td><td>8</td><td>\$7447.76</td><td>\$14 902.95</td><td></td><td>\$85 641.87</td></tr><tr><td>3</td><td>\$ 85 641.87</td><td>8</td><td>\$6851.35</td><td>\$14 902.95</td><td></td><td>\$77 590.27</td></tr><tr><td>4</td><td>\$ 77 590.27</td><td>8</td><td>\$6207.22</td><td>\$14 902.95</td><td></td><td>\$68 894.54</td></tr><tr><td>5</td><td>\$ 68 894.54</td><td>8</td><td>\$5511.56</td><td>\$14 902.95</td><td></td><td>\$59 503.15</td></tr><tr><td>6</td><td>\$ 59 503.15</td><td>8</td><td>\$4760.25</td><td>\$14 902.95</td><td></td><td>\$49 360.46</td></tr><tr><td>7</td><td>\$ 49 360.46</td><td>8</td><td>\$3948.84</td><td>\$14 902.95</td><td></td><td>\$38 406.34</td></tr><tr><td>8</td><td>\$ 38 406.34</td><td>8</td><td>\$3072.51</td><td>\$14 902.95</td><td></td><td>\$26 575.90</td></tr><tr><td>9</td><td>\$ 26 575.90</td><td>8</td><td>\$2126.07</td><td>\$14 902.95</td><td></td><td>\$13 799.03</td></tr><tr><td>10</td><td>\$ 13 799.03</td><td>8</td><td>\$1103.92</td><td>\$14 902.95</td><td></td><td>\$ 0.00</td></tr></table> <div>a) What is the period of the loan? b) What is the amount of the annual payment? c) How much of the annual payment at the end of Year 5 went toward the opening balance? Show how to determine the answer in two different ways. d) Create an algebraic expression to find the answer in c). e) If the interest rate went up to 11% in Year 10, how much would be owing at the end of Year 10? f) What extra payment at the end of Year 4 would pay the loan off at the end of Year 8?</div>	Year	Opening Balance	Interest Rate (%)	Interest Charged	Regular Payment	Extra Payment	Closing Balance	1	\$100 000.00	8	\$8000.00	\$14 902.95		\$93 097.05	2	\$ 93 097.05	8	\$7447.76	\$14 902.95		\$85 641.87	3	\$ 85 641.87	8	\$6851.35	\$14 902.95		\$77 590.27	4	\$ 77 590.27	8	\$6207.22	\$14 902.95		\$68 894.54	5	\$ 68 894.54	8	\$5511.56	\$14 902.95		\$59 503.15	6	\$ 59 503.15	8	\$4760.25	\$14 902.95		\$49 360.46	7	\$ 49 360.46	8	\$3948.84	\$14 902.95		\$38 406.34	8	\$ 38 406.34	8	\$3072.51	\$14 902.95		\$26 575.90	9	\$ 26 575.90	8	\$2126.07	\$14 902.95		\$13 799.03	10	\$ 13 799.03	8	\$1103.92	\$14 902.95		\$ 0.00
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General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Explain and illustrate the structure and the interrelationship of the sets of numbers within the real number system.</p> <p><b>Specific Outcomes</b></p> <p>C1–3. Classify numbers as natural, whole, integer, rational or irrational, and show that these number sets are nested within the real number system. [C, R, V]</p> <p>C1–4. Use approximate representations of irrational numbers. [R, T]</p>	<p>3.1 Explain why the number <math>1.11211121112 \dots</math> is irrational.</p> <p>3.2 Given a set of numbers, place them in their appropriate box in a nested Venn diagram.</p> <p>3.3 Describe, orally and in writing, whether or not a number is irrational.</p> <p>3.4 Demonstrate that a particular real number, such as <math>\sqrt{3}</math>, is rational or irrational.</p> <p>4.1 Compare the results of using different approximations for <math>\sqrt{2}</math> in calculations.</p> <p>a) Calculate <math>\sqrt{2} \times \sqrt{2}</math> as <math>1.4 \times 1.4</math>.</p> <p>b) Calculate <math>\sqrt{2} \times \sqrt{2}</math> as <math>1.41 \times 1.41</math>.</p> <p>4.2 Use a calculator to get the approximate value, to four decimal places, of <math>\sqrt{8}</math> and of <math>2\sqrt{2}</math>.</p>



**Strand: Number (Number Operations)***Students will:*

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

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General and Specific Outcomes	Illustrative Examples [Discretionary]
<b>General Outcome</b>  Use basic arithmetic operations on real numbers to solve problems.  <b>Specific Outcomes</b>  C1–5. Communicate a set of instructions used to solve an arithmetic problem. [C]  C1–6. Perform arithmetic operations on irrational numbers, using appropriate decimal approximations. [E, T]	5.1 Write a set of instructions that will allow another student to find: a) $1 + 2 \div 3$ b) $9 \times 4 \div 3 \times 5$ c) the reciprocal of a square root of a number, using a scientific calculator d) a 5% commission on a sale of \$40 200.  6.1 Mahal indicates that $\sqrt{2} + \sqrt{8}$ has an approximate value of 3.16. Use estimates to show whether Mahal's answer is reasonable, and use a calculator to verify the accuracy of Mahal's answer.  6.2 Find a decimal approximation of $\frac{3}{\sqrt{5} - \sqrt{2}}$ to three decimal places.  6.3 Arrange the following in order of value from least to greatest: $7, 2\sqrt{13}, 3\sqrt{6}, 4\sqrt{5}, 5\sqrt{2}$ . Use decimal approximations.  6.4 Evaluate $\sqrt[3]{128} + 4(\sqrt[3]{16})$ to three decimal places.  6.5 Find the length of the base and the height of an equilateral triangle of area $24 \text{ cm}^2$ .

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General and Specific Outcomes	Illustrative Examples [Discretionary]												
<b>General Outcome</b>  Describe and apply arithmetic operations on tables to solve problems, using technology as required.  <b>Specific Outcomes</b>  C1–7. Create and modify tables from both recursive and nonrecursive situations. [PS, T, V]	<div>7.1<table border="1"><tr><th>Price</th><th>GST</th><th>PST</th><th>Total</th></tr><tr><td>\$120.00</td><td>\$ 8.40</td><td>\$12.84</td><td>\$141.24</td></tr><tr><td>\$275.00</td><td>\$19.25</td><td>\$29.43</td><td>\$323.68</td></tr></table><div><div>a) Modify the table to allow for a PST of 6.5% of the price before taxes.</div><div>b) If the price after both taxes is \$138.00 and PST is charged on the \$120.00 price before taxes, what is the rate of PST?</div></div></div> <div>7.2<p>In 1993, sales of a particular video game doubled every month. The game was released in May 1993 with sales of 32 000 for May. Prepare a table to illustrate the 1993 monthly sales figures. How many video games were sold in December 1993? Identify the assumptions you made when determining the solution.</p><p>In 1994, the demand for the video game peaked. Starting in January 1994, and every month thereafter, sales were cut to one quarter of what they were in the previous month. How many video games were sold in April 1994? If April 1994 was the last month of sales, how many video games were sold over the entire twelve months?</p></div>	Price	GST	PST	Total	\$120.00	\$ 8.40	\$12.84	\$141.24	\$275.00	\$19.25	\$29.43	\$323.68
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C1–8. Use and modify a spreadsheet template to model recursive situations. [PS, T, V]	<div>8.1 Modify the given template for a 10-year, \$85 000 farm mortgage with fixed annual payments, to allow for a change in interest rate.</div> <table><tr><th>Year</th><th>Opening Balance</th><th>Interest Rate (%)</th><th>Interest Charged</th><th>Regular Payment</th><th>Closing Balance</th></tr><tr><td>1</td><td>\$85 000.00</td><td>8</td><td>\$6800.00</td><td>\$12 667.51</td><td>\$79 132.49</td></tr><tr><td>2</td><td>\$79 132.49</td><td>8</td><td>\$6330.60</td><td>\$12 667.51</td><td>\$72 795.59</td></tr><tr><td>3</td><td>\$72 795.59</td><td>8</td><td>\$5823.65</td><td>\$12 667.51</td><td>\$65 951.73</td></tr><tr><td>4</td><td>\$65 951.73</td><td>8</td><td>\$5276.14</td><td>\$12 667.51</td><td>\$58 560.36</td></tr><tr><td>5</td><td>\$58 560.36</td><td>8</td><td>\$4684.83</td><td>\$12 667.51</td><td>\$50 577.68</td></tr><tr><td>6</td><td>\$50 577.68</td><td>8</td><td>\$4046.21</td><td>\$12 667.51</td><td>\$41 956.39</td></tr><tr><td>7</td><td>\$41 956.39</td><td>8</td><td>\$3356.51</td><td>\$12 667.51</td><td>\$32 645.39</td></tr><tr><td>8</td><td>\$32 645.39</td><td>8</td><td>\$2611.63</td><td>\$12 667.51</td><td>\$22 589.52</td></tr><tr><td>9</td><td>\$22 589.52</td><td>8</td><td>\$1807.16</td><td>\$12 667.51</td><td>\$11 729.17</td></tr><tr><td>10</td><td>\$11 729.17</td><td>8</td><td>\$ 938.33</td><td>\$12 667.51</td><td>\$ 0.00</td></tr></table> <div><div>a) What alternatives are open to the farmer, if the interest rate increases?</div><div>b) What alternatives are open to the farmer, if the interest rate decreases?</div></div> <div>8.2 Modify the template in illustrative example 8.1 to reflect a 25-year home mortgage with monthly payments that gives the customer the option of making an annual extra payment of \$1500 at the end of any year. Interest is charged monthly.</div>	Year	Opening Balance	Interest Rate (%)	Interest Charged	Regular Payment	Closing Balance	1	\$85 000.00	8	\$6800.00	\$12 667.51	\$79 132.49	2	\$79 132.49	8	\$6330.60	\$12 667.51	\$72 795.59	3	\$72 795.59	8	\$5823.65	\$12 667.51	\$65 951.73	4	\$65 951.73	8	\$5276.14	\$12 667.51	\$58 560.36	5	\$58 560.36	8	\$4684.83	\$12 667.51	\$50 577.68	6	\$50 577.68	8	\$4046.21	\$12 667.51	\$41 956.39	7	\$41 956.39	8	\$3356.51	\$12 667.51	\$32 645.39	8	\$32 645.39	8	\$2611.63	\$12 667.51	\$22 589.52	9	\$22 589.52	8	\$1807.16	\$12 667.51	\$11 729.17	10	\$11 729.17	8	\$ 938.33	\$12 667.51	\$ 0.00
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**Strand: Number (Number Operations)****Students will:**

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

- [C] Communication [PS] Problem Solving  
 [CN] Connections [R] Reasoning  
 [E] Estimation and [T] Technology  
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General and Specific Outcomes	Illustrative Examples [Discretionary]																																																																																																																																																						
<b>General Outcome</b>  Describe and apply arithmetic operations on tables to solve problems, using technology as required.  <b>Specific Outcomes</b>  A2–1. Solve problems involving combinations of tables, using: <ul style="list-style-type: none"><li>• addition or subtraction of two tables</li><li>• multiplication of a table by a real number</li><li>• spreadsheet functions and templates.</li></ul> [PS, T, V]	<p>1.1 The following is an income and expenses report for a business for the year ending December 31.</p> <table><tr><th></th><th>Year 1</th><th>Year 2</th><th>Year 3</th><th>Year 4</th><th>Year 5</th></tr><tr><td>Sales</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Laundry</td><td>\$ 135 000</td><td>\$ 148 000</td><td>\$ 150 000</td><td>\$ 148 000</td><td>\$ 140 000</td></tr><tr><td>Dry Cleaning</td><td>45 000</td><td>47 000</td><td>48 000</td><td>45 000</td><td>45 000</td></tr><tr><td>Repairs and Sundry</td><td>10 000</td><td>11 000</td><td>11 000</td><td>10 000</td><td>9 000</td></tr><tr><td>Total Sales</td><td>\$ 190 000</td><td>\$ 206 000</td><td>\$ 209 000</td><td>\$ 203 000</td><td>\$ 194 000</td></tr><tr><td>Operating Expenses</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Salaries and Wages</td><td>\$ 94 000</td><td>\$ 99 000</td><td>\$ 101 000</td><td>\$ 101 000</td><td>\$ 96 000</td></tr><tr><td>Operating Supplies</td><td>22 000</td><td>24 000</td><td>25 000</td><td>24 000</td><td>23 000</td></tr><tr><td>Repairs and Misc.</td><td>4 000</td><td>5 000</td><td>6 000</td><td>8 000</td><td>5 000</td></tr><tr><td>Accounting and Legal</td><td>2 000</td><td>2 000</td><td>2 000</td><td>2 000</td><td>2 000</td></tr><tr><td>Advertising</td><td>2 000</td><td>2 000</td><td>2 000</td><td>2 000</td><td>2 000</td></tr><tr><td>Sundry</td><td>4 000</td><td>5 000</td><td>5 000</td><td>4 500</td><td>4 000</td></tr><tr><td>Total Operating Expenses</td><td>\$ 128 000</td><td>\$ 137 000</td><td>\$ 141 000</td><td>\$ 141 500</td><td>\$ 132 000</td></tr><tr><td>Profit Before Overhead</td><td>\$ 62 000</td><td>\$ 69 000</td><td>\$ 68 000</td><td>\$ 61 500</td><td>\$ 62 000</td></tr><tr><td>Overhead Expenses</td><td></td><td></td><td></td><td></td><td></td></tr><tr><td>Rent</td><td>\$ 12 000</td><td>\$ 14 000</td><td>\$ 16 000</td><td>\$ 18 000</td><td>\$ 18 000</td></tr><tr><td>Utilities</td><td>6 000</td><td>7 000</td><td>8 000</td><td>9 000</td><td>10 000</td></tr><tr><td>Insurance</td><td>3 000</td><td>3 000</td><td>3 000</td><td>3 000</td><td>3 000</td></tr><tr><td>Taxes and Licenses</td><td>3 000</td><td>3 000</td><td>4 000</td><td>4 000</td><td>5 000</td></tr><tr><td>Depreciation – Equip.</td><td>10 000</td><td>8 000</td><td>7 000</td><td>6 000</td><td>5 000</td></tr><tr><td>Total Overhead Exp.</td><td>\$ 34 000</td><td>\$ 35 000</td><td>\$ 38 000</td><td>\$ 40 000</td><td>\$ 41 000</td></tr><tr><td>Profit Before Tax</td><td>\$ 28 000</td><td>\$ 34 000</td><td>\$ 30 000</td><td>\$ 21 500</td><td>\$ 21 000</td></tr><tr><td>Income Tax</td><td>\$ 7 000</td><td>\$ 8 500</td><td>\$ 7 500</td><td>\$ 5 375</td><td>\$ 5 250</td></tr><tr><td>Net Profit</td><td>\$ 21 000</td><td>\$ 25 500</td><td>\$ 22 500</td><td>\$ 16 125</td><td>\$ 15 750</td></tr></table> <p>Enter the data above onto a spreadsheet template provided to students.</p> <p>1.1.1 a) Calculate the dollar change in total sales, total operating expenses and total overhead expenses, between each year in the table. b) Which is the greatest dollar change?</p>		Year 1	Year 2	Year 3	Year 4	Year 5	Sales						Laundry	\$ 135 000	\$ 148 000	\$ 150 000	\$ 148 000	\$ 140 000	Dry Cleaning	45 000	47 000	48 000	45 000	45 000	Repairs and Sundry	10 000	11 000	11 000	10 000	9 000	Total Sales	\$ 190 000	\$ 206 000	\$ 209 000	\$ 203 000	\$ 194 000	Operating Expenses						Salaries and Wages	\$ 94 000	\$ 99 000	\$ 101 000	\$ 101 000	\$ 96 000	Operating Supplies	22 000	24 000	25 000	24 000	23 000	Repairs and Misc.	4 000	5 000	6 000	8 000	5 000	Accounting and Legal	2 000	2 000	2 000	2 000	2 000	Advertising	2 000	2 000	2 000	2 000	2 000	Sundry	4 000	5 000	5 000	4 500	4 000	Total Operating Expenses	\$ 128 000	\$ 137 000	\$ 141 000	\$ 141 500	\$ 132 000	Profit Before Overhead	\$ 62 000	\$ 69 000	\$ 68 000	\$ 61 500	\$ 62 000	Overhead Expenses						Rent	\$ 12 000	\$ 14 000	\$ 16 000	\$ 18 000	\$ 18 000	Utilities	6 000	7 000	8 000	9 000	10 000	Insurance	3 000	3 000	3 000	3 000	3 000	Taxes and Licenses	3 000	3 000	4 000	4 000	5 000	Depreciation – Equip.	10 000	8 000	7 000	6 000	5 000	Total Overhead Exp.	\$ 34 000	\$ 35 000	\$ 38 000	\$ 40 000	\$ 41 000	Profit Before Tax	\$ 28 000	\$ 34 000	\$ 30 000	\$ 21 500	\$ 21 000	Income Tax	\$ 7 000	\$ 8 500	\$ 7 500	\$ 5 375	\$ 5 250	Net Profit	\$ 21 000	\$ 25 500	\$ 22 500	\$ 16 125	\$ 15 750
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General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>1.1.2 a) Calculate the percentage change in total sales, total operating expenses and total overhead expenses, between each year in the table. b) Which is the greatest percentage change?</p> <p>1.1.3 a) Determine the percentage change for each item for each year. b) Predict the figures for each type of income and expense for year 6, and predict the net profit for year 6.</p> <p>1.1.4 Prepare a line graph showing the annual sales, operating expenses and overhead expenses for the five year period. Use the graph to determine which item has the greatest rate of increase, and which item has the greatest rate of decrease.</p> <p>1.1.5 For the five year period, use a line of best fit procedure to determine equations of lines of best fit for total sales, total operating expenses and total overhead expenses. Use these equations to predict the values in year 6. From these values, predict the net profit in year 6.</p> <p>1.1.6 Calculate the net profit as a percentage of sales for each of the five years. In which year did the net profit represent the highest proportion of sales?</p> <p>1.1.7 Derive a formula relating total sales, total operating expenses, total overhead expenses, income tax and net profit.</p>

**Strand: Number (Number Operations)****Students will:**

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	<p>1.2 A banker needs to provide clients with information on foreign exchange. Use the foreign exchange chart provided, or a current chart from a newspaper, to answer the following questions.</p> <p>a) Calculate the cost in Canadian dollars of a refrigerator that costs \$850 US.</p> <p>b) Calculate the cost in US dollars of an outboard motor selling in Canada for \$1200.</p> <p>c) Hans receives a cheque for 100 Swiss francs from his uncle in Berne. How many Dutch guilders would he get for this cheque? How many Canadian dollars?</p> <p>d) Elsa is going on a holiday to Venezuela. She is told that she will have to pay \$3.48 US for every 100 bolivars. How many bolivars will she get for \$500 Canadian?</p> <p>February 1, 1996</p> <table><tr><th colspan="6">Foreign Exchange</th></tr><tr><th colspan="6">Cross Rates</th></tr><tr><th></th><th>Canadian dollar</th><th>US dollar</th><th>British pound</th><th>German mark</th><th>Japanese yen</th></tr><tr><td>Canada dollar</td><td>–</td><td>1.3743</td><td>2.0762</td><td>0.9227</td><td>0.012850</td></tr><tr><td>US dollar</td><td>0.7276</td><td>–</td><td>1.5107</td><td>0.6714</td><td>0.009350</td></tr><tr><td>British pound</td><td>0.4816</td><td>0.6619</td><td>–</td><td>0.4444</td><td>0.006189</td></tr><tr><td>German mark</td><td>1.0838</td><td>1.4894</td><td>2.2501</td><td>–</td><td>0.013927</td></tr><tr><td>Japanese yen</td><td>77.82</td><td>106.95</td><td>161.57</td><td>71.81</td><td>–</td></tr><tr><td>Swiss franc</td><td>0.8821</td><td>1.2122</td><td>1.8313</td><td>0.8139</td><td>0.011335</td></tr><tr><td>French franc</td><td>3.7230</td><td>5.1165</td><td>7.7297</td><td>3.4352</td><td>0.047841</td></tr><tr><td>Dutch guilder</td><td>1.2134</td><td>1.6676</td><td>2.5194</td><td>1.1196</td><td>0.015593</td></tr><tr><td>Italian lira</td><td>1156.07</td><td>1588.79</td><td>2400.23</td><td>1066.71</td><td>14.855491</td></tr></table> <table><tr><th colspan="5">Foreign Exchange</th></tr><tr><th colspan="5">Cross Rates</th></tr><tr><th></th><th>Swiss franc</th><th>French franc</th><th>Dutch guilder</th><th>Italian lira</th></tr><tr><td>Canada dollar</td><td>1.1337</td><td>0.2686</td><td>0.8241</td><td>0.000865</td></tr><tr><td>US dollar</td><td>0.8249</td><td>0.1954</td><td>0.5997</td><td>0.000629</td></tr><tr><td>British pound</td><td>0.5460</td><td>0.1294</td><td>0.3969</td><td>0.000417</td></tr><tr><td>German mark</td><td>1.2287</td><td>0.2911</td><td>0.8931</td><td>0.000937</td></tr><tr><td>Japanese yen</td><td>88.23</td><td>20.90</td><td>64.13</td><td>0.067315</td></tr><tr><td>Swiss franc</td><td>–</td><td>0.2369</td><td>0.7269</td><td>0.000763</td></tr><tr><td>French franc</td><td>4.2208</td><td>–</td><td>3.0681</td><td>0.003220</td></tr><tr><td>Dutch guilder</td><td>1.3757</td><td>0.3259</td><td>–</td><td>0.001050</td></tr><tr><td>Italian lira</td><td>1310.64</td><td>310.52</td><td>952.72</td><td>–</td></tr></table>	Foreign Exchange						Cross Rates							Canadian dollar	US dollar	British pound	German mark	Japanese yen	Canada dollar	–	1.3743	2.0762	0.9227	0.012850	US dollar	0.7276	–	1.5107	0.6714	0.009350	British pound	0.4816	0.6619	–	0.4444	0.006189	German mark	1.0838	1.4894	2.2501	–	0.013927	Japanese yen	77.82	106.95	161.57	71.81	–	Swiss franc	0.8821	1.2122	1.8313	0.8139	0.011335	French franc	3.7230	5.1165	7.7297	3.4352	0.047841	Dutch guilder	1.2134	1.6676	2.5194	1.1196	0.015593	Italian lira	1156.07	1588.79	2400.23	1066.71	14.855491	Foreign Exchange					Cross Rates						Swiss franc	French franc	Dutch guilder	Italian lira	Canada dollar	1.1337	0.2686	0.8241	0.000865	US dollar	0.8249	0.1954	0.5997	0.000629	British pound	0.5460	0.1294	0.3969	0.000417	German mark	1.2287	0.2911	0.8931	0.000937	Japanese yen	88.23	20.90	64.13	0.067315	Swiss franc	–	0.2369	0.7269	0.000763	French franc	4.2208	–	3.0681	0.003220	Dutch guilder	1.3757	0.3259	–	0.001050	Italian lira	1310.64	310.52	952.72	–
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**Strand: Patterns and Relations (Relations and Functions)***Students will:*

- use algebraic and graphical models to generalize patterns, make predictions and solve problems.

[C] Communication

[PS] Problem Solving

[CN] Connections

[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]																								
<b>General Outcome</b>  Examine the nature of relations with an emphasis on functions.  <b>Specific Outcomes</b>  C1–9. Plot linear and nonlinear data, using appropriate scales. [C, V]	<p>9.1 The mass of a beaker is recorded when the beaker contains varying volumes of ethanol. The results of the experiment are recorded in the table below.</p> <table><tr><th>Volume of Ethanol (mL)</th><th>Mass of Beaker and Liquid (g)</th></tr><tr><td>0</td><td>90</td></tr><tr><td>50</td><td>129</td></tr><tr><td>100</td><td>168</td></tr><tr><td>150</td><td>207</td></tr><tr><td>200</td><td>246</td></tr></table> <p>Measurements may be assumed correct to the nearest mL and to the nearest g.</p> <p>Plot this data on a scatterplot, using appropriate scales, and answer the following questions.</p> <ol style="list-style-type: none"><li>Assuming that this pattern continues, determine the mass of the beaker and liquid when 250 mL of ethanol is present.</li><li>When a volume of 200 mL of ethanol is in the beaker, determine the mass of the ethanol alone.</li><li>The density of a liquid is defined as the mass of 1 mL of the liquid. Determine the density of the ethanol.</li></ol> <p>9.2 Nannook's Pizza uses the following price structure.</p> <table><tr><th>Diameter (inches)</th><th>Cost (\$)</th></tr><tr><td>8</td><td>6.50</td></tr><tr><td>10</td><td>10.20</td></tr><tr><td>12</td><td>14.65</td></tr><tr><td>14</td><td>19.90</td></tr><tr><td>16</td><td>26.00</td></tr></table> <p>Plot this data on a scatterplot, using appropriate scales, and describe the pattern.</p>	Volume of Ethanol (mL)	Mass of Beaker and Liquid (g)	0	90	50	129	100	168	150	207	200	246	Diameter (inches)	Cost (\$)	8	6.50	10	10.20	12	14.65	14	19.90	16	26.00
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**Strand: Patterns and Relations (Relations and Functions)***Students will:*

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[C] Communication

[PS] Problem Solving

[CN] Connections

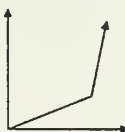

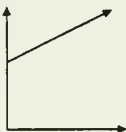

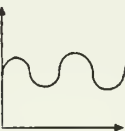
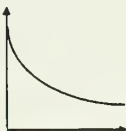
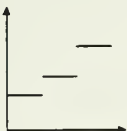
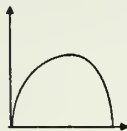
[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
C2-1. Represent data, using function models. [CN, PS, V]	<p>1.1 Sketch graphs to illustrate the following situations. If sufficient information is given, represent the situation by a suitable equation. Sketch and, if possible, represent by an equation:</p> <ol style="list-style-type: none"><li>a) the area of a circle as a function of its radius</li><li>b) the cost of mailing a letter as a function of the mass of the letter</li><li>c) the cost of renting a car for one day as a function of the kilometres driven</li><li>d) the population of Canada as a function of the year</li><li>e) the length of daylight as a function of the date.</li></ol> <p>1.2 For each of the following graphs, describe a practical situation that could be represented by the graph. In describing the situation, state the meanings of any intercepts, slopes, maxima and/or minima.</p> <div> </div>
C2-2. Use a graphing tool to draw the graph of a function from its equation. [C, T, V]	<p>2.1 Graph the function <math>y = x + 1</math>, using a graphing tool.</p> <p>2.2 Graph the function <math>y = x^2 + 100</math>, using a graphing tool. Explain the process used, so that the graph appears on the screen.</p>

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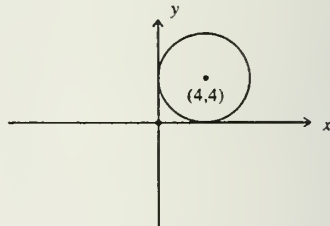
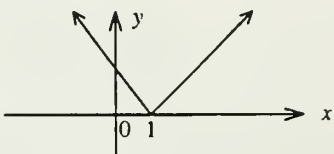
[R] Reasoning

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General and Specific Outcomes	Illustrative Examples [Discretionary]
<p>C2-3. Describe a function in terms of:</p> <ul style="list-style-type: none"> <li>• ordered pairs</li> <li>• a rule, in word or equation form</li> <li>• a graph.</li> </ul> <p>[C, CN, V]</p>	<p>3.1 Describe the parking charges at a parkade in terms of ordered pairs, a rule and a graph.</p>
<p>C2-4. Use function notation to evaluate and represent functions. [C, PS]</p>	<p>4.1 If <math>f(x) = x^2 - 5x + 3</math>, find <math>f(2)</math>. What is an ordered pair describing the point on the graph having a y-coordinate of <math>f(2)</math>?</p> <p>4.2 If <math>f(x) = 3x^2 - 6x + 5</math>, find <math>f(\sqrt{3})</math>, <math>f(2x)</math> and <math>f(3t + 2)</math>.</p>
<p>C2-5. Determine the domain and range of a relation from its graph. [PS, V]</p>	<p>5.1 If the coordinate axes touch the circle, what is the domain and range of the circle shown in the graph to the right?</p>  <p>5.2 Determine, from its graph shown below, the domain and range of the function <math>y =  x - 1 </math>.</p> 
<p>C2-6. Determine the following characteristics of the graph of a linear function, given its equation:</p> <ul style="list-style-type: none"> <li>• intercepts</li> <li>• slope</li> <li>• domain</li> <li>• range.</li> </ul> <p>[PS, V]</p>	<p>6.1 A tanker truck drives on a weigh scale and then is filled with crude oil. The mass <math>M</math>, measured in kilograms, of the truck and the volume <math>V</math>, measured in barrels, of crude oil are related by the formula:</p> $M = 14\,000 + 180V; V \leq 500.$ <p>a) Draw the graph with <math>V</math> on the horizontal axis and <math>M</math> on the vertical axis.</p> <p>b) The tank has a maximum capacity of 500 barrels. What is the mass of the truck when it contains 500 barrels of oil?</p> <p>c) What is the mass of the empty truck? Where is this value found on the graph?</p> <p>d) Find the slope, and give an interpretation for it.</p> <p>e) Give the domain for this problem.</p> <p>f) Express the range in words.</p>



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Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>6.2 Graph each of the following equations; and indicate intercepts, slope, domain and range.</p> <p>a) <math>y = 2x</math>; <math>x = (0, 1, 2, 3, 4, 5, 6)</math></p> <p>b) <math>y = -\frac{1}{3}x</math>; <math>x = \text{a real number}</math></p> <p>c) <math>y = 3</math></p> <p>d) <math>x = 3</math></p> <p>e) <math>y = \frac{1}{3}x + 5</math>; <math>x = \text{a real number}</math></p> <p>f) <math>y = mx + b</math>; <math>x = \text{a real number}</math></p>
<p><b>General Outcome</b></p> <p>Represent data, using linear function models.</p> <p><b>Specific Outcomes</b></p> <p>C2-7. Use direct variation and arithmetic sequences as applications of linear functions. [CN, PS, V]</p>	<p>7.1 A hydrologist studied the relationship between the pressure on an object and its depth of submersion in a liquid. The following graph was sketched.</p> <p>Draw conclusions based upon the sketch.</p> <div data-bbox="798 1251 1241 1487" data-label="Figure"> <p>The graph shows a linear relationship between Pressure (kPa) and Depth (m). The y-axis is labeled 'Pressure (kPa)' and has a tick mark at 100. The x-axis is labeled 'Depth (m)'. A straight line starts at the point (0, 100) on the y-axis and extends upwards and to the right with a constant positive slope.</p> </div> <p>7.2 Simple interest varies directly with the amount borrowed.</p> <p>a) If the interest is \$5 for \$100 borrowed, what would the interest be for \$325 borrowed?</p> <p>b) Graph the relation, and write the equation of the graph.</p>

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General and Specific Outcomes	Illustrative Examples [Discretionary]										
	<p>7.3 A jet ski rental operation at Lake Okanagan charges a fixed insurance premium, plus an hourly rate. The total cost for two hours is \$50 and for five hours is \$110.</p> <p>a) Graph the relation.</p> <p>b) Determine the fixed insurance premium and the hourly rate to rent the jet ski.</p> <p>7.4 With new equipment coming on line, a soft drink manufacturer has been increasing its production each day according to the following table. Assume a maximum daily output of 25 000 cans.</p> <table><tr><td>Day</td><td>1</td><td>2</td><td>3</td><td>4</td></tr><tr><td>Units</td><td>4000</td><td>4200</td><td>4400</td><td>4600</td></tr></table> <p>a) Graph the relation. Hint: this is a discrete case.</p> <p>b) On what day will they be able to produce 20 000 cans, if this trend continues?</p> <p>7.5 Given the distance–time graph shown, answer the following questions.</p> <p>a) If <math>D = 850</math>, what is <math>t</math>?</p> <p>b) If <math>t = 25</math>, what is <math>D</math>?</p> <p>c) If <math>D = 1500</math>, what is <math>t</math>?</p> <p>d) Write the equation of the function.</p> <p>e) Verify the accuracy of your estimates in a), b) and c), using the equation of the function.</p>	Day	1	2	3	4	Units	4000	4200	4400	4600
Day	1	2	3	4							
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[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]										
	<p>7.6 Given the data in the table, predict the fuel consumption for the following engines:</p> <p>a) 2.5 L b) 5.0 L.</p> <table><tr><th><u>Engine Size (L)</u></th><th><u>Consumption ( L/100 km)</u></th></tr><tr><td>2.2</td><td>6.4</td></tr><tr><td>3.0</td><td>7.5</td></tr><tr><td>3.8</td><td>8.1</td></tr><tr><td>4.1</td><td>8.6</td></tr></table>	<u>Engine Size (L)</u>	<u>Consumption ( L/100 km)</u>	2.2	6.4	3.0	7.5	3.8	8.1	4.1	8.6
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3.0	7.5										
3.8	8.1										
4.1	8.6										
	<p>7.7 A video game operator gives all her change in quarters. From a \$20 bill, she gives 56 quarters change for a \$6 purchase. She gives 8 quarters change from a \$20 bill for an \$18 purchase.</p> <p>a) Graph the number of quarters given as change <math>N</math> on the vertical axis and the amount of the purchase <math>P</math> on the horizontal axis. Assume that a \$20 bill was given.</p> <p>b) What is the domain and range of the function?</p> <p>c) How does the graph change, if a \$10 bill is used?</p>										

**Strand: Shape and Space (Measurement)***Students will:*

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication

[PS] Problem Solving

[CN] Connections

[R] Reasoning

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[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Demonstrate an understanding of scale factors, and their interrelationship with the dimensions of similar shapes and objects.</p> <p><b>Specific Outcomes</b></p> <p>C3–1. Calculate the volume and surface area of a sphere, using formulas that are provided. [CN, PS, V]</p> <p>C3–2. Determine the relationships among linear scale factors, areas, the surface areas and the volumes of similar figures and objects. [CN, PS, R, V]</p>	<p>1.1 Calculate the volume and surface area of a beach ball of radius 15 cm.</p> <p>1.2 A hot air balloon has a spherical shape and a diameter of 4 m. If 30 additional cubic metres of air are pumped into the balloon, what will be the new values for the diameter, volume and surface area?</p> <p>2.1 The area of a region in a plane is <math>10 \text{ cm}^2</math>. By what factor must each of the dimensions of this region be multiplied to increase the area by <math>20 \text{ cm}^2</math>?</p> <p>2.2 A model train is built to a scale of 1:50. If the length of the model engine is 20 cm and the area of sheet metal used to cover the outside surface of the model is <math>180 \text{ cm}^2</math>, what is the actual length of the engine and the actual area of the sheeting used to cover the engine? If the volume displaced by the model engine is <math>126 \text{ cm}^3</math>, what is the volume displaced by the real engine, in <math>\text{m}^3</math>?</p> <p>2.3 It is improbable that a giant human, 6 m in height (three or four times normal human height), could exist. Which biological systems are most likely to break down? Explain your answer.</p>

**Strand: Shape and Space (Measurement)***Students will:*

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[PS] Problem Solving

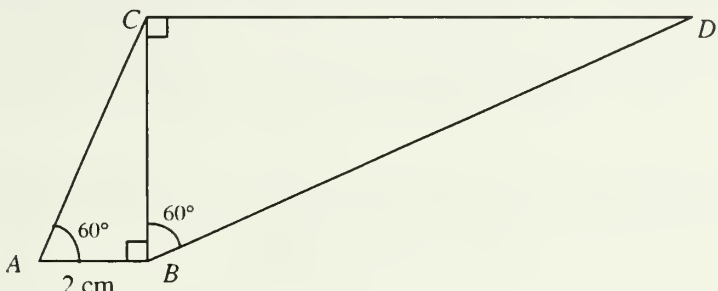
[CN] Connections

[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Solve problems involving triangles, including those found in 3-D and 2-D applications.</p> <p><b>Specific Outcomes</b></p> <p>C3–3. Solve problems involving two right triangles. [CN, PS, V]</p> <p>C3–4. Extend the concepts of sine and cosine for angles from <math>0^\circ</math> to <math>180^\circ</math>. [R, T, V]</p>	<p>3.1 From the top of a 100 m fire tower, a fire ranger observes two fires, one at an angle of depression of <math>5^\circ</math> and the other at an angle of depression of <math>2^\circ</math>. Assuming that the fires and the tower are in a straight line, determine the distance between the fires for the following:</p> <ol style="list-style-type: none"> <li>when the fires are on the same side of the tower</li> <li>when the fires are on opposite sides of the tower.</li> </ol> <p>3.2 The triangles <math>ABC</math> and <math>BCD</math> have right angles at <math>B</math> and <math>C</math> respectively. Calculate the length of side <math>CD</math>, and state the ratio of length <math>BD</math> to length <math>AC</math>.</p>  <p>3.3 Canada's highest waterfall is Della Falls on Vancouver Island. An observer standing at the same level as the base of the falls views the top of the falls at an angle of elevation of <math>58^\circ</math>. When the observer moves 31 m closer to the base of the falls, the angle of elevation increases to <math>61^\circ</math>. Find the height of Della Falls.</p> <p>4.1 Find <math>\sin 130^\circ</math>.</p> <p>4.2 Use a calculator to find multiple solutions for angle <math>A</math>, if <math>\sin A = \sin 130^\circ</math>. Use trial and error to find as many solutions as possible. Summarize the pattern found in the solutions.</p>



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[C] Communication

[PS] Problem Solving

[CN] Connections

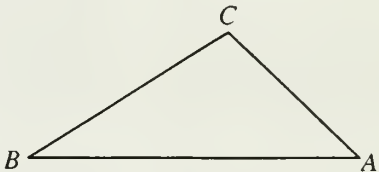
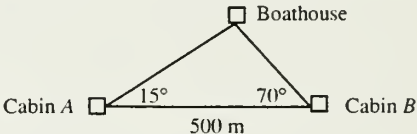
[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
C3–5. Apply the sine and cosine laws, excluding the ambiguous case, to solve problems. [CN, PS, V]	<p>4.3 Find the value(s) for <math>A</math> (<math>0^\circ \leq A \leq 180^\circ</math>) when <math>\sin A = \frac{1}{2}</math>. Find the value(s) for <math>A</math> (<math>0^\circ \leq A \leq 180^\circ</math>) when <math>\cos A = \frac{1}{2}</math>. Find the value(s) for <math>A</math> (<math>0^\circ \leq A \leq 180^\circ</math>) when <math>\cos A = -\frac{1}{2}</math>.</p> <p>5.1 An electric transmission line is planned to go directly over a pond. The power line will be supported by posts at points <math>A</math> and <math>B</math>. A surveyor measures the distance from <math>B</math> to <math>C</math> as 580 m, the distance from <math>A</math> to <math>C</math> as 337 m and <math>\angle BCA</math> as <math>105.34^\circ</math>. What is the distance from post <math>A</math> to post <math>B</math>?</p>  <p>5.2 Two cabins are located 500 m apart on the same side of a river. Across the river from the two cabins is a boathouse. This situation is illustrated in the diagram below. Use the measurements to find the width of the river.</p>  <p>5.3 A farmer has a field in the shape of a triangle. From one corner, it is 530 m to the second corner and 750 m to the third corner. The angle between the lines of sight to the second and to the third corners is <math>53^\circ</math>. Find the perimeter and area of the field.</p> <p>5.4 A sailboat leaves the dock at Gibson's Landing on a bearing of <math>S57^\circ W</math>. After sailing for 8 km, the ship tacks and travels <math>S31^\circ E</math> for 5 km. a) How far is the sailboat from Gibson's Landing? b) What direction would it have to sail to return to the dock at Gibson's Landing?</p> <p>Marshall P. Bye et al. Holt, Rinehart and Winston of Canada, Limited. By permission of CanCopy Agreement, 1998.</p>

**Strand: Shape and Space (Measurement)***Students will:*

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[C] Communication

[PS] Problem Solving

[CN] Connections

[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Use measuring devices to make estimates and to perform calculations in solving problems.</p> <p><b>Specific Outcomes</b></p> <p>A1–1. Select and apply appropriate instruments, units of measure (in SI and Imperial systems) and measurement strategies to find lengths, areas and volumes. [E, PS, T]</p>	<p>1.1 Find a rule that relates hectares to acres. Is there a rule of thumb that can be used for estimates? Estimate the area of a plot of land shown in a plan, using both units of measurement.</p> <p>1.2 Use a micrometer to measure the thickness of 10 sheets of paper. Use the results of this measurement to determine the thickness of one sheet of paper.</p> <p>1.3 Use a micrometer to measure the thickness of a human hair.</p> <p>1.4 Calculate the area of a flat rectangular surface measuring 21 m by 14 m. Give the answer in <math>\text{cm}^2</math>, <math>\text{m}^2</math> and <math>\text{dm}^2</math>.</p> <p>1.5 Estimate the volume of a water bed bladder having a depth of 300 mm, a width of 1.8 m and a length of 210 cm.</p> <p>1.6 Given a cylindrical pipe of known length, choose appropriate measuring devices to find the internal and external diameters of the pipe. Find the volume of metal in the pipe. Explain your measurement and calculation procedures.</p> <p>1.7 Measure the internal dimensions of a rectangular container, and calculate its volume in <math>\text{cm}^3</math>. Find its volume, in litres or in millilitres, using a calibrated cylinder.</p> <p>1.8 Use a vernier calliper to measure the inside diameter of a piece of PVC pipe.</p> <p>1.9 Measure the angle between two faces of a pyramid to the nearest degree.</p> <p>1.10 Measure the angle of a bevel to the nearest tenth of a degree, using a vernier bevel protractor.</p>



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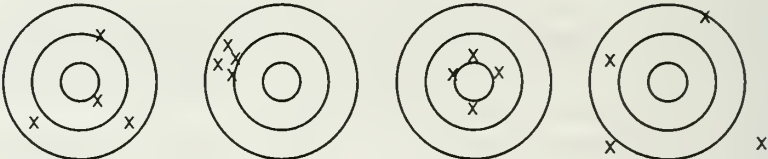
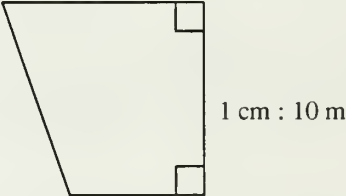
[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
A1–2. Analyze the limitations of measuring instruments and measurement strategies, using the concepts of precision and accuracy. [C, R]	<p>2.1 Which ruler is most precise?</p> <p>a) a ruler divided into tenths of an inch b) a ruler divided into eighths of an inch c) a ruler divided into millimetres.</p> <p>2.2 Of the four diagrams revealing shots on a target, which best represents accuracy and precision?</p> 
A1–3. Solve problems involving length, area, volume, time, mass and rates derived from these. [C, E, PS]	<p>3.1 A room is 16 feet long, 12 feet wide and 8 feet high. The walls and ceiling are to be painted. There are two doors in the room, each 6 feet 6 inches high and 30 inches wide. There are two windows, each 2 feet by 4 feet. Information on the paint can states that you should allow 3.79 L for every 38 m<sup>2</sup> of smooth surface. Two coats of paint are needed. How many cans of paint are needed, if each can contains 3.79 L? If the painter is able to paint 3 m<sup>2</sup> in 10 minutes, how long will it take to paint the room?</p> <p>3.2 A person buys a property that is irregularly shaped. See scale drawing below.</p>  <p>1 cm : 10 m</p> <p>What is the total area, in m<sup>2</sup>, of the lot?</p> <p>3.3 A car has a highway fuel consumption of 34 miles per Imperial gallon. What is this in litres per 100 kilometres? Explain the conversion strategy used.</p>

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**[C]** Communication**[PS]** Problem Solving**[CN]** Connections**[R]** Reasoning**[E]** Estimation and**[T]** Technology

Mental Mathematics

**[V]** Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>3.4 A sheet metal worker must fabricate a pyramidal cap for a square column. The base of the cap is 1.5 m by 1.5 m and the height is 5 m. Determine the area of material required.</p> <div data-bbox="669 551 913 702"></div> <div data-bbox="1135 534 1339 698"></div>
	<p>3.5 A building contractor is to provide wheel chair access to a new building. A space of 10 m by 10 m is available, on the west side of the entrance stairs, for a ramp. Municipal building codes specify that wheel chair ramps must have a minimum width of 1.5 m and a maximum slope of <math>10^\circ</math>. The vertical rise needed is 2 m. Construction costs for ramps of this kind average \$300 per linear metre.</p> <p>a) Design a ramp to meet the above specifications.</p> <p>b) Make a plan or drawing of the proposed ramp showing the measurements, including the slopes, of the various parts.</p> <p>c) Give an estimate of the cost of construction.</p>

**Strand:** Shape and Space (Measurement)*Students will:*

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication

[PS] Problem Solving

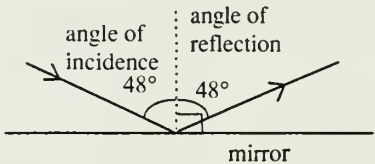
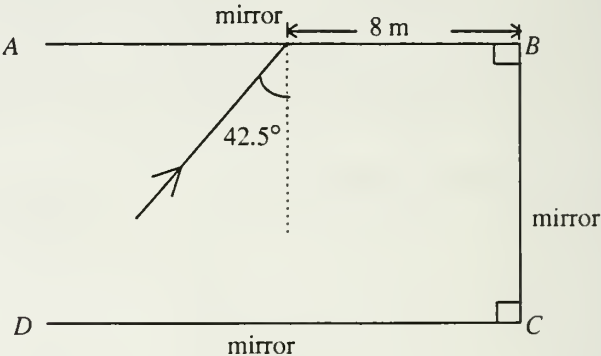
[CN] Connections

[R] Reasoning

[E] Estimation and  
Mental Mathematics

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p>A1–4. Interpret drawings, and use the information to solve problems. [C, PS, V]</p>	<p>4.1 The law of reflection states that when a ray of light is reflected at a surface, the angle of reflection is equal to the angle of incidence. Therefore, if light hits a mirror at an angle of incidence of <math>48^\circ</math>, the angle of reflection will also be <math>48^\circ</math>.</p>  <p>The following diagram of the interior of a hall of mirrors shows a ray of light hitting mirror <math>AB</math> at a point 8 m from <math>B</math> and at an angle of incidence of <math>42.5^\circ</math>. Using the law of reflection, and either trigonometric relationships or scale drawings, find the angle of reflection from mirror <math>CD</math> and the distance from <math>C</math> at which the ray will hit mirror <math>CD</math>, if mirror <math>BC</math> is 12 m long.</p> 

**Strand: Shape and Space (Measurement)***Students will:*

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication

[PS] Problem Solving

[CN] Connections

[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p data-bbox="576 430 1398 493">4.2 A silver box, with dimensions as outlined below, is made from sheet metal.</p> <div data-bbox="762 520 1081 685"></div> <p data-bbox="647 710 1137 741">Two methods of construction are shown.</p> <p data-bbox="647 783 672 814">a)</p> <div data-bbox="651 783 1413 996"></div> <p data-bbox="647 1062 672 1094">b)</p> <div data-bbox="719 1062 1403 1265"></div> <p data-bbox="647 1311 1403 1384">The material cost is \$2.50/cm<sup>2</sup>, and soldering costs \$0.70/cm. For each method of construction, calculate the cost for the box.</p>

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

## Mental Mathematics

[V] Visualization

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**Strand: Shape and Space (3-D Objects and 2-D Shapes)***Students will:*

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

[C] Communication [PS] Problem Solving  
 [CN] Connections [R] Reasoning  
 [E] Estimation and [T] Technology  
 Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
C1–12. Solve problems involving rise, run and slope of line segments. [PS, V]	<p>12.1 If the slope of a line is 6 (<math>m = 6</math>) and the line passes through the points (2, 5) and (1, <math>k</math>), what is the value of <math>k</math>?</p> <p>12.2 If two points on a line are (4, 3) and (6, 4), find one other point on the line. Use a graphing utility to demonstrate the reasonableness of your answer.</p>
C1–13. Determine the equation of a line, given information that uniquely determines the line. [PS, V]	<p>13.1 Use a graphing device to examine changes in the graph of <math>y = mx + b</math> as the values of <math>m</math> and <math>b</math> are changed. Use the results to explain why the equation <math>y = mx + b</math> is called the slope and y-intercept form of a linear equation.</p> <p>13.2 Write a clear explanation of the nature of the following lines: <math>x = a</math>, <math>y = b</math>, <math>x = y</math>.</p> <p>13.3 Manipulate the standard form of a straight line (<math>Ax + By + C = 0</math>) into the slope and y-intercept form of the same line. Determine rules that connect <math>A</math>, <math>B</math> and <math>C</math> to the slope (<math>m</math>) and to the intercepts.</p> <p>13.4 Find the equation of a line passing through the points (–1, 3) and (4, 2).</p> <p>13.5 Given the graph of an oblique line, determine an equation for the line.</p> <p>13.6 A spring with no masses attached is 25.2 cm long. For each 1-g mass attached to the spring, the spring's length increases by 4 mm. Graph this scenario, label the axes, and find an equation for the graph.</p>
C1–14. Solve problems using slopes of: <ul style="list-style-type: none"> <li>parallel lines</li> <li>perpendicular lines.</li> </ul> [CN, PS, V]	<p>14.1 Graphically examine the slopes of various lines, all of which are perpendicular to the line <math>y = \frac{2}{3}x + 2</math>. Describe the slopes, and make a rule for finding the slope of a perpendicular to a given line.</p> <p>14.2 Two perpendicular lines intersect on the <math>x</math>-axis. The equation of one of the lines is <math>y = 2x - 6</math>. Find the equation of the second line.</p>

**Strand: Statistics and Probability (Data Analysis)****Students will:**

- collect, display and analyze data to make predictions about a population.

- |  |                      |
|--|----------------------|
| [C] Communication                        | [PS] Problem Solving |
| [CN] Connections                         | [R] Reasoning        |
| [E] Estimation and<br>Mental Mathematics | [T] Technology       |
|  | [V] Visualization    |

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Implement and analyze sampling procedures, and draw appropriate inferences from the data collected.</p> <p><b>Specific Outcomes</b></p> <p>C3–6. Choose, justify and apply sampling techniques that will result in an appropriate, unbiased sample from a given population. [C, PS, R]</p> <p>C3–7. Defend or oppose inferences and generalizations about populations, based on data from samples. [C, PS, R]</p>	<p>6.1 A toothpaste company advertises that three out of four dentists prefer their product. Analyze this statement for its completeness and its accuracy in terms of population, sample, possible sampling technique, validity and bias.</p> <p>6.2 A school cafeteria wants to introduce a new dessert. Describe how a survey could be conducted to decide which of three choices should be the new dessert.</p> <p>6.3 To predict a winner in a federal election, a magazine compiled a list of about 200 000 names from sources, such as telephone books, lists of automobile owners, club membership lists and its own subscription lists. The magazine mailed a questionnaire to everybody on the list, and 4000 returned it. The 4000 responses became the sample. Discuss the potential sources of bias.</p> <p>7.1 To determine a preference for spending \$50 in either a clothing store, an electronics shop or a restaurant, customers were surveyed one Saturday morning at the mall. Fifty-nine per cent preferred spending in a clothing store, 32% in an electronics shop and 9% in a restaurant. What generalizations can be made from these results? Does the sample adequately represent the population to be surveyed? Design a more reliable sampling method to obtain this information, and include details of the questionnaires used and the method of selecting the sample.</p> <p>7.2 Search through various forms of media to find examples of generalizations that have been made about populations, based on data from samples. Do you agree or disagree with the generalizations? Explain why.</p>



**Strand: Statistics and Probability (Data Analysis)***Students will:*

- collect, display and analyze data to make predictions about a population.

[C] Communication

[PS] Problem Solving

[CN] Connections

[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

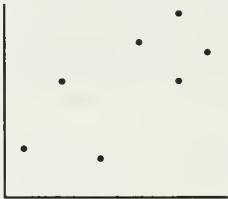

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]																																										
<p><b>General Outcome</b></p> <p>Apply line-fitting and correlation techniques to analyze experimental results.</p> <p><b>Specific Outcomes</b></p> <p>A2-2. Determine the equation of a line of best fit, using:</p> <ul style="list-style-type: none"><li>• estimate of slope and one point</li><li>• median–median method</li><li>• least squares method with technology.</li></ul> <p>[CN, PS, T, V]</p>	<p>2.1 Below are the heights, in metres, and masses, in kilograms, of 13 students.</p> <table><tr><th>Student</th><th>Height (m)</th><th>Mass(kg)</th></tr><tr><td><i>a</i></td><td>1.50</td><td>51</td></tr><tr><td><i>b</i></td><td>1.51</td><td>56</td></tr><tr><td><i>c</i></td><td>1.52</td><td>54</td></tr><tr><td><i>d</i></td><td>1.54</td><td>58</td></tr><tr><td><i>e</i></td><td>1.56</td><td>56</td></tr><tr><td><i>f</i></td><td>1.58</td><td>62</td></tr><tr><td><i>g</i></td><td>1.60</td><td>91</td></tr><tr><td><i>h</i></td><td>1.61</td><td>65</td></tr><tr><td><i>i</i></td><td>1.64</td><td>66</td></tr><tr><td><i>j</i></td><td>1.65</td><td>70</td></tr><tr><td><i>k</i></td><td>1.66</td><td>71</td></tr><tr><td><i>l</i></td><td>1.70</td><td>74</td></tr><tr><td><i>m</i></td><td>1.72</td><td>74</td></tr></table> <p>Plot the data and determine lines of best fit, using:</p> <ol style="list-style-type: none"><li>estimation</li><li>median–median method</li><li>least squares method and a computing tool.</li></ol> <p>Calculate the slope and intercept of each of the lines, and compare the results.</p>	Student	Height (m)	Mass(kg)	<i>a</i>	1.50	51	<i>b</i>	1.51	56	<i>c</i>	1.52	54	<i>d</i>	1.54	58	<i>e</i>	1.56	56	<i>f</i>	1.58	62	<i>g</i>	1.60	91	<i>h</i>	1.61	65	<i>i</i>	1.64	66	<i>j</i>	1.65	70	<i>k</i>	1.66	71	<i>l</i>	1.70	74	<i>m</i>	1.72	74
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**Strand: Statistics and Probability (Data Analysis)***Students will:*

- collect, display and analyze data to make predictions about a population.

[C] Communication [PS] Problem Solving  
 [CN] Connections [R] Reasoning  
 [E] Estimation and [T] Technology  
 Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]																												
A2-3. Use technological devices to determine the correlation coefficient $r$ . [T]	2.2 <table border="1"><tr><td>Oil changes per year</td><td>3</td><td>5</td><td>2</td><td>3</td><td>1</td><td>4</td><td>6</td><td>4</td><td>3</td><td>2</td><td>0</td><td>10</td><td>7</td></tr><tr><td>Cost of repairs</td><td>\$300</td><td>300</td><td>500</td><td>400</td><td>700</td><td>400</td><td>100</td><td>250</td><td>450</td><td>650</td><td>600</td><td>0</td><td>150</td></tr></table> <p>a) Use graphing technology to prepare a scatterplot. Draw a line of best fit.</p> <p>b) From the line of best fit, make predictions of the repair cost with eight oil changes and with 14 oil changes.</p> <p>c) How reliable are these predictions?</p> <p>d) Beyond what point are the predictions unreliable?</p> <p>Excerpted and adapted with permission from <i>Data Analysis and Statistics (Curriculum and Evaluation Addenda Series, Grades 9–12)</i>, copyright 1992 by the National Council of Teachers of Mathematics. All rights reserved.</p>	Oil changes per year	3	5	2	3	1	4	6	4	3	2	0	10	7	Cost of repairs	\$300	300	500	400	700	400	100	250	450	650	600	0	150
	Oil changes per year	3	5	2	3	1	4	6	4	3	2	0	10	7															
	Cost of repairs	\$300	300	500	400	700	400	100	250	450	650	600	0	150															
	A2-4. Interpret the correlation coefficient $r$ and its limitations for varying problem situations, using relevant scatterplots. [C, R, V]	3.1 Measure the height of each person in a class and the distance, from fingertip to fingertip, of their outstretched arms.																											
	4.1 What do the following scatterplots and corresponding $r$ -values represent?																												
	<div><div>Scatterplot (1)</div><div><div>Student Marks</div><div></div><div>Shoe Size</div></div></div> <div><div>Scatterplot (2)</div><div><div>Student Marks</div><div></div><div>Study Time</div></div></div> <p>Scatterplot (1) is the plot of student marks on their last test against their shoe size. The value for <math>r</math> was calculated to be 0.2. Scatterplot (2) is the plot of student marks on their last test against the time spent studying. The value for <math>r</math> was calculated to be 0.8. Describe the relationship between the values of <math>r</math> and the shape of the scatterplots.</p>																												

## APPLIED MATHEMATICS 20

**Strand:** Number (Number Operations)

*Students will:*

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C] Communication

[CN] Connections

[E] Estimation and

Mental Mathematics

[PS] Problem Solving

[R] Reasoning

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Solve consumer problems, using arithmetic operations.</p> <p><b>Specific Outcomes</b></p> <p>C4-1. Solve consumer problems, including:</p> <ul style="list-style-type: none"> <li>• wages earned in various situations</li> <li>• property taxation</li> <li>• exchange rates</li> <li>• unit prices.</li> </ul> <p>[CN, E, PS, R, T]</p>	<p>1.1 Calculate and compare wage situations involving minimum wage rates, regular pay, overtime pay, gratuities, piecework, straight commission, salary and commission, salary plus quota and graduated commission.</p> <p>1.2 Jane has a choice of two restaurants at which to work. Mario's pays \$8/h, and tips average \$24 daily. Teppan's pays \$5.50/h, and tips average \$35 daily. If Jane works 30 hours weekly, spread over four days, how much would she earn at each restaurant?</p> <p>1.3 Identify and calculate various payroll deductions, including income tax, CPP, UI, medical benefits, union and professional dues and life insurance premiums.</p> <p>1.4 Estimate, calculate and compare gross and net pay for various wage or salary earners in your community.</p> <p>1.5 The Ningart property has a market value of \$105 000. The assessed values in the area are 60% of market values. The tax rate is 32.3 mills of assessed value. What is the Ningarts' monthly tax payment?</p> <p>1.6 The exchange rate on a given day in the United States is 28% and in Canada 38.8%. Explain why this is possible.</p> <p>1.7 A Canadian traveller goes from Switzerland to Germany. She knows that one Swiss franc is equivalent to \$1.26 Canadian (including exchange cost) and that one German mark is \$0.97 Canadian (including exchange cost). How many German marks does she get for 100 Swiss francs?</p> <p>1.8 Which provides better value for tomato soup, \$0.69 for 284 mL or \$1.79 for 907 mL?</p>

**Strand: Number (Number Operations)****Students will:**

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C]	Communication	[PS]	Problem Solving
[CN]	Connections	[R]	Reasoning
[E]	Estimation and Mental Mathematics	[T]	Technology
		[V]	Visualization


General and Specific Outcomes	Illustrative Examples [Discretionary]																																																								
C4-2. Reconcile financial statements including: <ul style="list-style-type: none"><li>• cheque books with bank statements</li><li>• cash register tallies with daily receipts.</li></ul> [CN, PS, T]	<div>2.1 The following petty cash transactions occurred during the first week of March.  March 4 \$100 cheque was received to establish the fund. March 5 Bought \$12.50 worth of postage stamps. March 5 Spent \$10 to have something delivered by taxi. March 6 Spent \$6.50 for lunch. March 7 Paid a courier service \$25 for deliveries. March 7 Bought flowers for opening day, \$28. March 8 Replenished the fund by \$25. March 9 Postage stamps purchased for \$21.50.  Determine if a final balance of \$20 is correct. If not, provide an explanation for the difference, and indicate possible ways to correct the problem.</div> <div>2.2 Complete the table below to determine the cost of credit for using a department store charge account for the period shown. Monthly credit charges are 1.4% of the balance due.</div> <table><tr><th>Month</th><th>Previous Balance</th><th>- Payment Made</th><th>+ Purchases Charged</th><th>=&gt; Balance Due</th><th>+ Credit Charges</th><th>=&gt; New Balance</th></tr><tr><td>February</td><td>\$314.65</td><td>\$100.00</td><td>\$193.75</td><td></td><td>\$5.72</td><td>\$414.12</td></tr><tr><td>March</td><td></td><td>\$150.00</td><td>\$ 59.60</td><td></td><td></td><td></td></tr><tr><td>April</td><td></td><td>\$140.00</td><td>\$421.83</td><td></td><td></td><td>\$618.62</td></tr><tr><td>May</td><td>\$618.62</td><td>\$200.00</td><td>\$ 39.65</td><td></td><td></td><td></td></tr><tr><td>June</td><td></td><td>\$250.00</td><td>\$ 58.11</td><td></td><td></td><td></td></tr><tr><td>July</td><td></td><td>\$150.00</td><td>\$ 77.21</td><td></td><td></td><td></td></tr><tr><td>August</td><td>\$206.68</td><td>\$120.00</td><td>\$163.09</td><td></td><td>\$3.50</td><td>\$253.27</td></tr></table>	Month	Previous Balance	- Payment Made	+ Purchases Charged	=> Balance Due	+ Credit Charges	=> New Balance	February	\$314.65	\$100.00	\$193.75		\$5.72	\$414.12	March		\$150.00	\$ 59.60				April		\$140.00	\$421.83			\$618.62	May	\$618.62	\$200.00	\$ 39.65				June		\$250.00	\$ 58.11				July		\$150.00	\$ 77.21				August	\$206.68	\$120.00	\$163.09		\$3.50	\$253.27
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C4-3. Solve budget problems, using graphs and tables to communicate solutions. [C, PS, T, V]	<div>3.1 Research and calculate the cost of running a car for a year. Decide how to classify each cost, how to collect the data and how to display the results.</div> <div>3.2 As a project, prepare a monthly budget for one of the following:<ul style="list-style-type: none"><li>a) the family</li><li>b) an assumed persona; e.g., Wayne Gretzky</li><li>c) a school</li><li>d) a vacation</li><li>e) a fishing/hunting/shopping trip</li><li>f) a municipality.</li></ul></div>																																																								



**Strand: Number (Number Operations)****Students will:**

- demonstrate an understanding of and proficiency with calculations
- decide which arithmetic operation or operations can be used to solve a problem and then solve the problem.

[C] Communication [PS] Problem Solving  
 [CN] Connections [R] Reasoning  
 [E] Estimation and [T] Technology  
 Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]																												
<p>C4-4. Plot and describe data of exponential form, using appropriate scales. [C, T, V]</p>	<p>3.3 The diagram shows Julie's monthly budget of \$1200. She wants to move to her own apartment that costs \$450 per month. Construct a new budget that will include her rent. Explain the choices and changes that Julie could make.</p> <p>Julie Barnes' Monthly Budget Total = \$1200</p>  <p>4.1 The growth of the value of a \$7000 RRSP is as follows:</p> <table border="1" data-bbox="644 1094 952 1301"> <thead> <tr> <th>Time (years)</th><th>Value (\$)</th></tr> </thead> <tbody> <tr><td>0</td><td>7 000</td></tr> <tr><td>1</td><td>7 630</td></tr> <tr><td>2</td><td>8 316</td></tr> <tr><td>3</td><td>9 065</td></tr> <tr><td>4</td><td>9 881</td></tr> <tr><td>5</td><td>10 770</td></tr> </tbody> </table> <p>Plot this data, estimate the time needed for the RRSP to reach \$14 000, and determine the value of the RRSP after 12 years.</p> <p>4.2 Plot the world population on the vertical axis and the date on the horizontal axis. Use the graph to predict the date when the population reached 4 billion and to predict the present population of the world.</p> <table border="1" data-bbox="647 1508 1040 1736"> <thead> <tr> <th>Date</th><th>Population</th></tr> </thead> <tbody> <tr><td>1650</td><td>500 000 000</td></tr> <tr><td>1850</td><td>1 100 000 000</td></tr> <tr><td>1930</td><td>2 000 000 000</td></tr> <tr><td>1950</td><td>2 500 000 000</td></tr> <tr><td>1970</td><td>3 600 000 000</td></tr> <tr><td>1988</td><td>5 100 000 000</td></tr> </tbody> </table>	Time (years)	Value (\$)	0	7 000	1	7 630	2	8 316	3	9 065	4	9 881	5	10 770	Date	Population	1650	500 000 000	1850	1 100 000 000	1930	2 000 000 000	1950	2 500 000 000	1970	3 600 000 000	1988	5 100 000 000
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**Strand: Number (Number Operations)****Students will:**

- demonstrate an understanding of and proficiency with calculations
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[C]	Communication	[PS]	Problem Solving
[CN]	Connections	[R]	Reasoning
[E]	Estimation and Mental Mathematics	[T]	Technology
		[V]	Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
C4–5. Solve investment and credit problems involving simple and compound interest. [CN, PS, T]	<p>5.1 Determine the effective annual interest rate on a loan of \$1000 at 10% per year, compounded quarterly.</p> <p>5.2 Calculate the compound amount, after one year, of a deposit of \$1000. Assume the current nominal annual interest when the interest is compounded:</p> <ol style="list-style-type: none"><li>a) annually</li><li>b) monthly</li><li>c) daily.</li></ol> <p>5.3 A bank offers an interest rate of 8% per year, compounded annually. A second bank offers an interest rate of 8% per year, compounded quarterly. If \$2000 were deposited, for ten years, in each bank, how much more income would be gained in the second bank than in the first?</p> <p>5.4 Calculate the interest paid on various forms of credit, including:</p> <ol style="list-style-type: none"><li>a) credit cards</li><li>b) loans</li><li>c) mortgages.</li></ol> <p>5.5 A loan of \$5000 carries an interest rate of 9% per year, compounded monthly. Adele makes a payment of \$350 every month. Use a spreadsheet to determine how much she still owes after making 12 payments.</p> <p>5.6 Compare two investments in an RRSP for one year with contributions starting January 1.</p> <ol style="list-style-type: none"><li>a) \$100 is invested monthly at 10% per annum, compounded monthly.</li><li>b) \$600 is invested semi-annually at 10% per annum, compounded semi-annually.</li></ol>



**Strand:** Patterns and Relations (Variables and Equations)

*Students will:*

- represent algebraic expressions in multiple ways.

[C] Communication

[PS] Problem Solving

[CN] Connections

[R] Reasoning

[E] Estimation and  
Mental Mathematics

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Represent and analyze situations that involve expressions, equations and inequalities.</p> <p><b>Specific Outcomes</b></p> <p>C5–1. Graph linear inequalities, in two variables. [PS, V]</p> <p>C5–2. Solve systems of linear equations, in two variables:            • algebraically (elimination and substitution)            • graphically.            [CN, PS, T, V]</p> <p>C5–3. Solve nonlinear equations, using a graphing tool.            [CN, T, V]</p>	<p>1.1 Solve, algebraically and graphically, for <math>x</math>:  <math>2x + 5 &gt; 3x - 1</math>.</p> <p>1.2 A target is described in terms of coordinates <math>(x, y)</math>, where <math>x</math> and <math>y</math> are measured in metres. All of the following are true:            • <math>x \leq 6</math>            • <math>y \geq 7</math>            • <math>(x, y)</math> is in the first quadrant            • <math>x + y \leq 10</math>.            What is the shape and the area of the target?</p> <p>2.1 Solve this system of equations, using the elimination method:  <math>x + 2y = 10</math>  <math>2x + 3y = 14</math>.</p> <p>2.2 Solve this system of equations, using the substitution method:  <math>3x + 4y = 15</math>  <math>x - y = 5</math>.</p> <p>2.3 A principal of \$42 000 is invested partly at 7% and partly at 9.5%. If the interest is \$3700, how much is invested at each interest rate?</p> <p>2.4 Plot the graphs of <math>2x + 3y = 11</math> and <math>2x - 3y = 17</math>. What is their point of intersection?</p> <p>3.1 Using a graphing tool, solve <math>x^2 + 6x - 11 = 0</math>.</p> <p>3.2 Solve <math>x^3 + x = 30</math> graphically, using two different methods. Which method gives solutions that are freer from rounding errors and other inaccuracies?</p> <p>3.3 Where does the line <math>y = 4x + 5</math> cut the curve <math>y = 2^x</math>? Use a graphing tool to find the points of intersection.</p>

**Strand: Patterns and Relations (Variables and Equations)***Students will:*

- represent algebraic expressions in multiple ways.

[C] Communication

[PS] Problem Solving

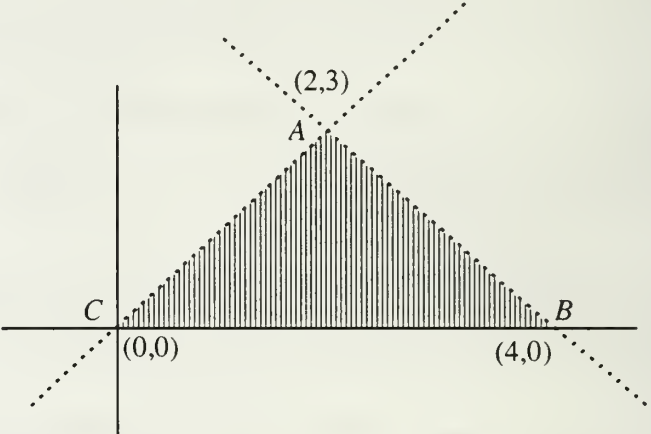
[CN] Connections

[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<b>General Outcome</b>  Use linear programming to solve optimization problems.  <b>Specific Outcomes</b>  A5-1. Solve, graphically, systems of linear inequalities, in two variables, using technology. [CN, PS, T, V]	<p>1.1 Graph the solution to the following system of inequalities: <math>3x - y &gt; 4</math> <math>2x + y \leq 6</math>.</p> <p>1.2 Given the following diagram, provide the system of inequalities whose solution is the interior of <math>\triangle ABC</math>.</p>  <p>2.1 A farmer has chickens and turkeys. He has fewer than 100 birds. He sells chickens for \$10 each and turkeys for \$30 each, and he earns more than \$1500. Represent the situation graphically, and shade the region containing possible solutions.</p> <p>2.2 A desktop publisher has to design formats for rectangular data tables and uses graphing grids as a design tool. Shade the region on the grid that represents the possible dimensions of rectangles in which the length is less than twice the width, the perimeter is at most 48 cm, and the area is at least <math>32 \text{ cm}^2</math>.</p>
A5-2. Design and solve linear and nonlinear systems, in two variables, to model problem situations. [C, CN, PS, R, V]	

**Strand: Patterns and Relations (Variables and Equations)***Students will:*

- represent algebraic expressions in multiple ways.

[C] Communication

[PS] Problem Solving

[CN] Connections

[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

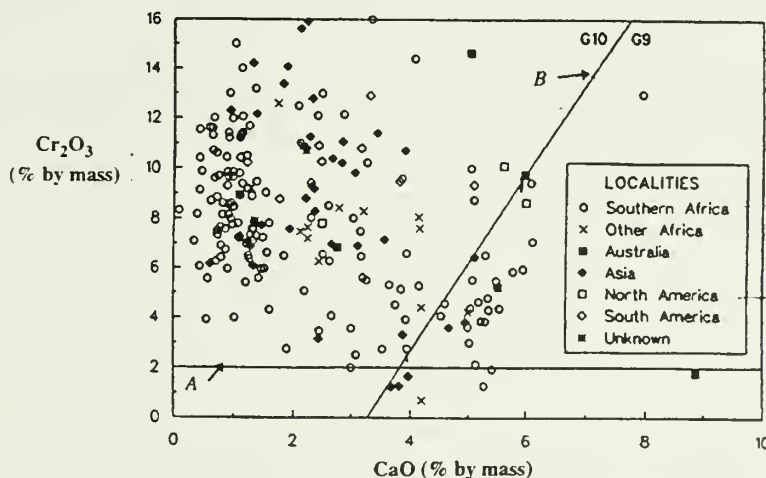
[V] Visualization

**General and Specific Outcomes****Illustrative Examples [Discretionary]**

2.3 Diamond prospecting is done by testing the garnets found in rocks called kimberlites for the per cent content of  $\text{Cr}_2\text{O}_3$  and  $\text{CaO}$ . The following graph shows the  $\text{Cr}_2\text{O}_3$  to  $\text{CaO}$  ratio for diamond-bearing rocks worldwide. Diamonds occur 85% of the time with garnets classed as G10. This G10 area is defined by the function lines A and B.

- Define the system of linear inequalities that determines the G10 area.
- Which of the following samples would indicate that further prospecting is warranted?

Garnet Sample No.	Garnet mass (g)	$\text{Cr}_2\text{O}_3$ mass (g)	$\text{CaO}$ mass (g)
1	16.1	1.71	1.35
2	8.7	0.094	0.72
3	4.2	0.35	0.051
4	12.0	1.80	0.61



A5-3. Apply linear programming to find optimal solutions to decision-making problems.  
[C, PS, R, T, V]

- 3.1 An agricultural club has a 10 ha plot of land available for a market garden project. It has selected corn and potatoes to plant and has \$4000 for the project. The corn will cost \$300/ha to grow and will generate \$375/ha gross income. The potatoes will cost \$500/ha to grow and will generate \$650/ha gross income.
- Construct the function that describes the revenue from the project.
  - Construct the inequalities that describe the restrictions.
  - Plot this system of inequalities.
  - Identify the feasible solutions.
  - Determine the optimal solution.

**Strand: Patterns and Relations (Variables and Equations)***Students will:*

- represent algebraic expressions in multiple ways.

[C] Communication

[PS] Problem Solving

[CN] Connections

[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>3.2 A manufacturing company originally has three employees. The company directive is to hire additional persons to build widgets. Widgets can only be built by teams of 2 people. Eight teams can produce 500 widgets and 10 teams can produce 600 widgets. It is assumed that a linear relation exists between the number of teams and the number of widgets produced. The plant has the capacity to produce 1000 widgets. The Department of Health limits the total number of employees in the building to 15, due to the air quality problem. Using multimedia techniques and linear programming, write a presentation to the board of directors explaining how to optimize production.</p> <p>3.3 Find the maximum and minimum values of the quantity <math>C</math>, where <math>C = 2x - 5y</math>, given the constraints:</p> $\begin{aligned}x &\geq 0 \\y &\geq 0 \\x &\leq 12 \\y &\leq x + 8 \\x + 2y &\leq 28 \\3x + y &\leq 39.\end{aligned}$

**Strand: Patterns and Relations (Relations and Functions)***Students will:*

- use algebraic and graphical models to generalize patterns, make predictions and solve problems.

[C] Communication

[CN] Connections

[E] Estimation and

Mental Mathematics

[PS] Problem Solving

[R] Reasoning

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Represent and analyze quadratic, polynomial and rational functions, using technology as appropriate.</p> <p><b>Specific Outcomes</b></p> <p>C5–4. Determine the following characteristics of the graph of a quadratic function:</p> <ul style="list-style-type: none"> <li>• vertex</li> <li>• domain and range</li> <li>• axis of symmetry</li> <li>• intercepts.</li> </ul> <p>[C, PS, T, V]</p>	<p>4.1 Given the graph of any quadratic function, determine the following:</p> <ol style="list-style-type: none"> <li>vertex</li> <li>domain</li> <li>range</li> <li>axis of symmetry</li> <li>intercepts.</li> </ol> <p>4.2 Use technology to graph <math>f(x) = x^2 - 6x + 4</math> and to determine the vertex, domain, range, axis of symmetry and intercepts.</p> <p>4.3 One model concerning the rate of population growth of Earth has the annual rate of increase varying jointly as the population and the unused carrying capacity of Earth. The equation of the model is:  <math>y = 0.001x(21 - x)</math>, where <math>y</math> = the rate of increase in population (in billions per year), and <math>x</math> = the present population (in billions).</p> <ol style="list-style-type: none"> <li>Plot this model of growth.</li> <li>The present population of Earth is 5.8 billion. What is the annual increase in population at present?</li> <li>What is the population when the rate of increase in population is at its greatest?</li> <li>What is the population when the rate of increase is zero?</li> <li>What is the projected maximum population that Earth can accommodate, according to this model?</li> </ol>



**Strand: Shape and Space (Measurement)***Students will:*

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication

[PS] Problem Solving

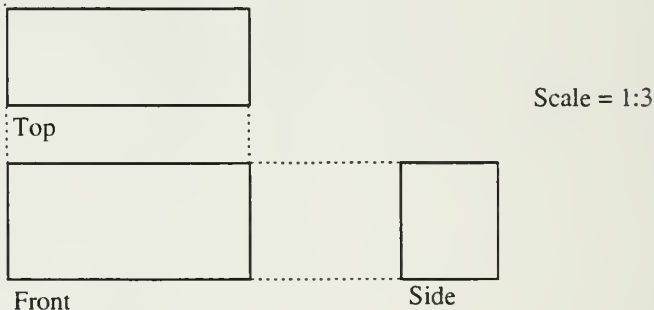
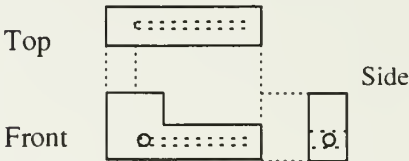
[CN] Connections

[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Demonstrate an understanding of scale factors, and their interrelationship with the dimensions of similar shapes and objects.</p> <p><b>Specific Outcomes</b></p> <p>A3-1. Enlarge or reduce a dimensioned object, according to a specified scale. [C, CN, PS, V]</p>	<p>1.1 A classroom has dimensions of nine metres by eight metres. Produce a scale drawing of the classroom to a scale of 1:50.</p> <p>1.2 Using surveyor's chains, tapes or other linear measuring devices, measure a chosen plot of land, and calculate its area. Make a scale drawing, using the same measurement system for the drawing as was used with the measurement instruments.</p> <p>1.3 From the scale drawing below, construct an actual sized model of the box.</p> <div data-bbox="665 1114 1318 1425" style="text-align: center;">  <p>Top</p> <p>Front</p> <p>Side</p> <p>Scale = 1:3</p> </div> <p>1.4 To better visualize an object, architects often build clay models. Use molding clay to build a model of the object that is shown in the plan below. Scale = 2:3</p> <div data-bbox="662 1645 1070 1806" style="text-align: center;">  <p>Top</p> <p>Front</p> <p>Side</p> </div>

**Strand: Shape and Space (Measurement)***Students will:*

- describe and compare everyday phenomena, using either direct or indirect measurement.

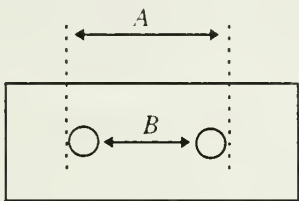
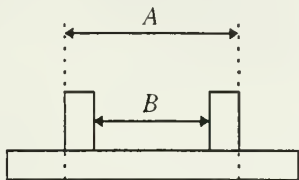
[C] Communication

[PS] Problem Solving

[CN] Connections

[R] Reasoning

[E] Estimation and  
Mental Mathematics[T] Technology  
[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<b>General Outcome</b>  Use measuring devices to make estimates and to perform calculations in solving problems.  <b>Specific Outcomes</b>  A3–2. Calculate maximum and minimum values, using tolerances, for lengths, areas and volumes. [PS, R, V]	<p>2.1 The diagrams represent the top and side views of a drawer handle. If the tolerance specifications are as shown below, determine the maximum and minimum dimensions for the distance between the two centres.</p> <div style="display: flex; justify-content: space-around; align-items: center;"><div style="text-align: center;"></div><div style="text-align: center;"></div></div> <div style="display: flex; justify-content: space-around; align-items: center;"><div style="text-align: center;"><p>Figure 1: Top View</p><p><math>A = 10.50 \pm 0.02 \text{ cm}</math> <math>B = 8.20 \pm 0.04 \text{ cm}</math></p></div><div style="text-align: center;"><p>Figure 2: Side View</p></div></div> <p>2.2 To carry a high electric current to an LRT car, a wire must have a cross-sectional area of <math>45 \pm 2 \text{ mm}^2</math>. What are the maximum and minimum diameters allowed for this wire?</p> <p>2.3 Steel ball bearings have a diameter of <math>0.80 \pm 0.02 \text{ cm}</math>. Find the volume of one ball bearing, in <math>\text{cm}^3</math>, with the tolerance included. What is the maximum number of such ball bearings that can be made from <math>1000 \text{ cm}^3</math> of steel?</p> <p>A3–3. Solve problems involving percentage error when input variables are expressed with percentage errors. [PS, R, V]</p> <p>3.1 A rectangular table was measured to be 420 cm long and 170 cm wide. The length was measured with an error of 1.5% and the width with an error of 2%. Calculate the maximum and minimum possible areas, and estimate the percentage error in the calculated area.</p>

**Strand: Shape and Space (Measurement)***Students will:*

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication [PS] Problem Solving  
[CN] Connections [R] Reasoning  
[E] Estimation and [T] Technology  
Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
A3–4. Design an appropriate measuring process or device to solve a problem. [E, PS, V]	3.2 An experiment is done to find the density of a ball bearing. The mass is measured to be 473 g, with a percentage error of 4%. The diameter is measured to be $5.1 \text{ cm} \pm 2\%$ . a) Calculate the density of the ball bearing, showing its percentage error. b) Which is more effective in reducing percentage error: using a new balance that gives a mass of $473 \text{ g} \pm 1.5\%$ , or using a new calliper that gives a diameter of $5.1 \text{ cm} \pm 1\%$ ? Justify your answer with appropriate calculations.
	4.1 Design and construct a measuring device; e.g., a planimeter with a horizontal vernier scale and cardboard wheel, graduated accordingly. Apply the constructed instrument to find, according to scale, the areas of large, irregular shapes.
	4.2 To calculate the loss of wheat after a hailstorm, a farmer counts the number of broken wheat heads in a small area, calculates the proportion of broken heads in the sample and extrapolates this proportion to the entire field. Explain the process used to gather the data, and explain how the estimate of loss is determined.

**Strand: Shape and Space (3-D Objects and 2-D Shapes)***Students will:*

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

[C] Communication

[PS] Problem Solving

[CN] Connections

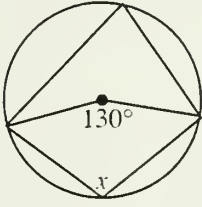
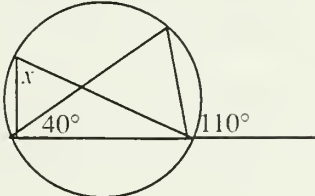
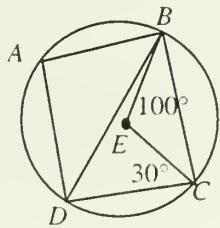
[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Develop and apply the geometric properties of circles and polygons to solve problems.</p> <p><b>Specific Outcomes</b></p> <p>C5–5. Use technology and measurement to confirm and apply the following properties to particular cases:</p> <ul style="list-style-type: none"> <li>the perpendicular from the centre of a circle to a chord bisects the chord</li> <li>the measure of the central angle is equal to twice the measure of the inscribed angle subtended by the same arc</li> <li>the inscribed angles subtended by the same arc are congruent</li> <li>the angle inscribed in a semicircle is a right angle</li> <li>the opposite angles of a cyclic quadrilateral are supplementary</li> <li>a tangent to a circle is perpendicular to the radius at the point of tangency</li> <li>the tangent segments to a circle, from any external point, are congruent</li> <li>the angle between a tangent and a chord is equal to the inscribed angle on the opposite side of the chord</li> <li>the sum of the interior angles of an <math>n</math>-sided polygon is <math>(2n - 4)</math> right angles.</li> </ul> <p>[PS, R, T, V]</p>	<p>5.1 A plate, with a diameter of 20 cm, is placed on a square place mat, with no overhang. Calculate the length of the diagonal of the square.</p> <p>5.2 Determine the measure of angle <math>x</math>.</p>  <p>5.3 Determine the measure of angle <math>x</math>.</p>  <p>5.4 Draw a semicircle with diameter <math>AB</math>. Draw an angle, <math>ACB</math>, with <math>C</math> being any point on the semicircle. What is the measure of angle <math>ACB</math>? Repeat for two other points, <math>C'</math> and <math>C''</math>, on the semicircle. What pattern emerges?</p> <p>5.5 Determine the measure of <math>\angle ECB</math>, <math>\angle BDC</math>, <math>\angle BAD</math> and <math>\angle DBE</math>, where <math>E</math> is the centre of the circle.</p> 

**Strand:** Shape and Space (3-D Objects and 2-D Shapes)

*Students will:*

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

[C] Communication

[CN] Connections

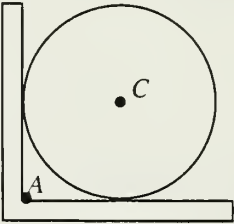
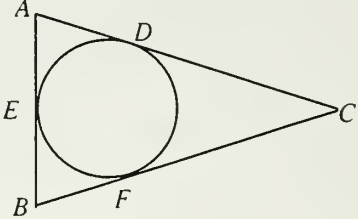
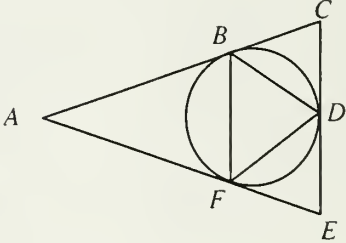
[E] Estimation and  
Mental Mathematics

[PS] Problem Solving

[R] Reasoning

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>5.6 How far from the inside corner of the shelf, <math>A</math>, is the centre <math>C</math> of the plate, if the plate has a diameter of 20 cm?</p>  <p>5.7 The perimeter of the isosceles triangle <math>ABC</math>, with <math>AC = BC</math>, is 54 cm. If <math>AD = 5</math> cm, and <math>D, E</math> and <math>F</math> are points of tangency, find the length of <math>BC</math>.</p>  <p>5.8 Determine the measure of <math>\angle CAE</math>, if <math>\angle BDF = 60^\circ</math> and <math>\angle FDE = 70^\circ</math>.</p> 



**Strand:** Shape and Space (3-D Objects and 2-D Shapes)

*Students will:*

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

[C] Communication

[CN] Connections

[E] Estimation and  
Mental Mathematics

[PS] Problem Solving

[R] Reasoning

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Develop and apply the geometric properties of circles and polygons to solve problems.</p> <p><b>Specific Outcomes</b></p> <p>A3–5. Use properties of circles and polygons to solve design and layout problems. [CN, PS, V]</p>	<p>5.1 The pattern on a piece of vinyl flooring consists of a square and four equilateral triangles. Each equilateral triangle has as its base one side of the square. Circles are inscribed in each triangle and in the square.</p> <ol style="list-style-type: none"> <li>Start with a square of side length 6 cm. Draw the design, full size.</li> <li>Determine the ratio of the area of the small circle to the area of the large circle.</li> </ol> <p>5.2 A standard sheet of paper is 22 cm by 28 cm. The margins are 3 cm on the left, on the right and at the top. The bottom margin is 4 cm. A project summary consists of one table that is 10 cm by 6 cm, three tables that are 8 cm by 5 cm each and 50 cm<sup>2</sup> of text that can be arranged in any shape(s).</p> <ol style="list-style-type: none"> <li>Prepare a possible layout, assuming that the tables can be oriented with their long sides parallel to any edge of the paper.</li> <li>Prepare a possible layout, assuming that the long side of any table must be parallel to the top edge of the paper.</li> <li>What is the maximum area of text that can be included with the four tables, if each table must have at least 1 cm margins?</li> </ol> <p>5.3 A school has 325 students, all of whom have pictures to be put in the yearbook. The yearbook pages are 9.5 inches by 12 inches. The inside margins are 1.5 inches, the outside margins are 1 inch, the top margin is 1.2 inches, and the bottom margin is 1.5 inches. Each photograph is 53 mm by 35 mm. The minimum space between sides of pictures is 0.5 inches and between the bottom of one picture and the top of the next is 0.9 inches.</p> <ol style="list-style-type: none"> <li>How many photographs can be put on a single page?</li> <li>If the number of pages used must be divisible by 8, design a layout so that all 325 photographs can be included, without having any blank pages.</li> </ol>

**Strand: Shape and Space (3-D Objects and 2-D Shapes)****Students will:**

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

[C] Communication

[PS] Problem Solving

[CN] Connections

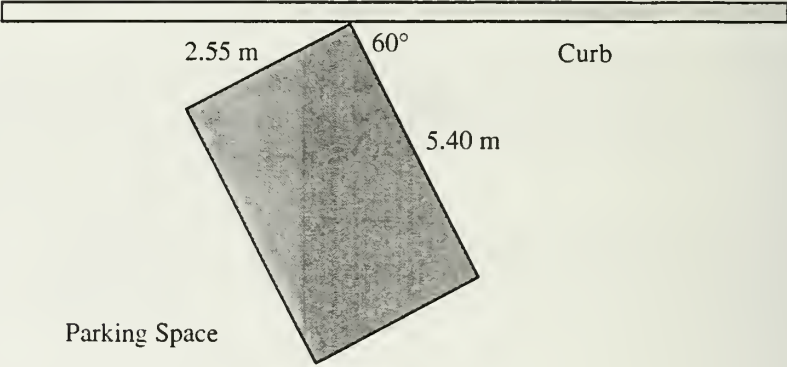
[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>5.4 An average automobile requires an angle parking space with dimensions of 2.55 m wide and 5.40 m long. If spaces are being calculated for parallel parking, each automobile will require an additional length of 1.20 m as manoeuvring room. A small town's main street currently uses <math>60^\circ</math> angle parking.</p>  <p>The town council has contracted you to provide information for town planning decisions regarding parking capacity.</p> <ol style="list-style-type: none"><li>Develop a formula for the number of spaces <math>N</math> for a given curb length <math>L</math> for <math>60^\circ</math> angle parking.</li><li>Two years later, increased traffic along the main street makes angle parking unsafe. The town council wants to know how many spaces <math>N</math> they will have for a given curb length <math>L</math>, if they switch to parallel parking.</li></ol> <p>The town's main street is 200 m long. If the town council wants to retain the same parking capacity as before, how many additional spaces will have to be developed away from the main street in order to offset the spaces lost by the switch to parallel parking?</p> <p>5.5 A cylindrical can is 12 cm high and 6 cm in diameter. The can is closed, top and bottom. It is cut from a rectangular sheet of metal, and then the pieces are sealed together to form the can.</p> <ol style="list-style-type: none"><li>Determine the smallest rectangle that can be used to make one can.</li><li>What percentage of the metal is wasted in part a)?</li><li>If seams require 2 mm of extra metal per join, what are the new dimensions of the smallest rectangle?</li></ol>

**Strand: Statistics and Probability (Data Analysis)***Students will:*

- collect, display and analyze data to make predictions about a population.

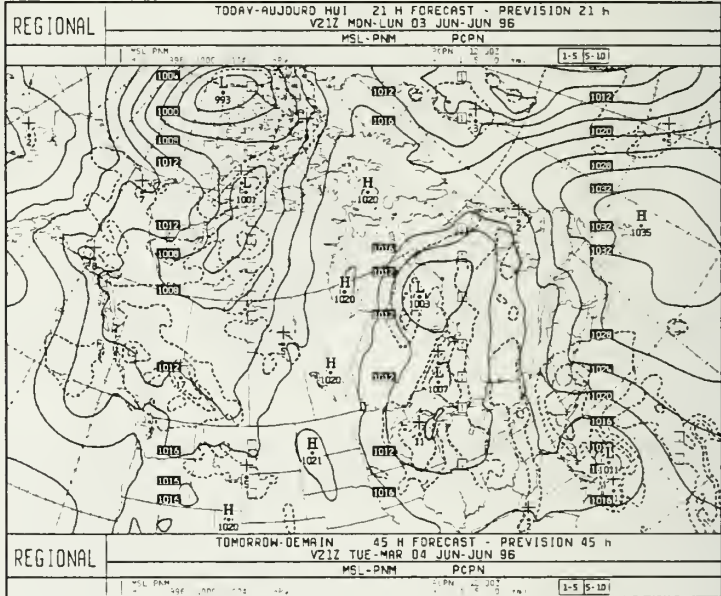
[C] Communication [PS] Problem Solving  
[CN] Connections [R] Reasoning  
[E] Estimation and [T] Technology  
Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]																																																				
<p><b>General Outcome</b></p> <p>Analyze graphs or charts of given situations to derive specific information.</p> <p><b>Specific Outcomes</b></p> <p>A4-1. Extract information from given graphs of discrete or continuous data, using:</p> <ul style="list-style-type: none"><li>• time series</li><li>• glyphs (custom pictorial representations)</li><li>• continuous data</li><li>• contour lines.</li></ul> <p>[C, CN, E, PS, R, V]</p>	<p>1.1 Sometimes points representing discrete data are joined, even though specific values for intermediate points may not be available. Give examples where such a practice is acceptable and other examples where it is not.</p> <p>1.2</p> <div><p>PROFIT/LOSS CYCLE FOR A DEPARTMENT STORE</p><table><caption>Estimated data from Profit/Loss Cycle graph</caption><tr><th>Month</th><th>Sales (Thousands)</th><th>Costs (Thousands)</th><th>Net Profit/Loss (Thousands)</th></tr><tr><td>Jan.</td><td>8</td><td>4</td><td>-4 (Net Loss)</td></tr><tr><td>Feb.</td><td>2</td><td>4</td><td>-2 (Net Loss)</td></tr><tr><td>Mar.</td><td>1</td><td>4</td><td>-3 (Net Loss)</td></tr><tr><td>Apr.</td><td>2</td><td>4</td><td>-2 (Net Loss)</td></tr><tr><td>May</td><td>4</td><td>4</td><td>0</td></tr><tr><td>June</td><td>4</td><td>4</td><td>0</td></tr><tr><td>July</td><td>5</td><td>4</td><td>1 (Net Profit)</td></tr><tr><td>Aug.</td><td>5</td><td>4</td><td>1 (Net Profit)</td></tr><tr><td>Sept.</td><td>4</td><td>4</td><td>0</td></tr><tr><td>Oct.</td><td>5</td><td>5</td><td>0</td></tr><tr><td>Nov.</td><td>10</td><td>5</td><td>5 (Net Profit)</td></tr><tr><td>Dec.</td><td>12</td><td>6</td><td>6 (Net Profit)</td></tr></table></div> <p>A department store may experience “peaks” and “troughs” in its revenue (sales). Christmas season and summer holidays are the two strongest periods. January to April can be the weakest period. If net profits are greater than net losses over the year, the business can stay in operation.</p> <ol style="list-style-type: none"><li>During periods of net loss, what might the business do for finances?</li><li>Over which of the two curves, Sales or Costs, does the business have the most managerial control?</li><li>Discuss the net profit for May.</li></ol>	Month	Sales (Thousands)	Costs (Thousands)	Net Profit/Loss (Thousands)	Jan.	8	4	-4 (Net Loss)	Feb.	2	4	-2 (Net Loss)	Mar.	1	4	-3 (Net Loss)	Apr.	2	4	-2 (Net Loss)	May	4	4	0	June	4	4	0	July	5	4	1 (Net Profit)	Aug.	5	4	1 (Net Profit)	Sept.	4	4	0	Oct.	5	5	0	Nov.	10	5	5 (Net Profit)	Dec.	12	6	6 (Net Profit)
Month	Sales (Thousands)	Costs (Thousands)	Net Profit/Loss (Thousands)																																																		
Jan.	8	4	-4 (Net Loss)																																																		
Feb.	2	4	-2 (Net Loss)																																																		
Mar.	1	4	-3 (Net Loss)																																																		
Apr.	2	4	-2 (Net Loss)																																																		
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July	5	4	1 (Net Profit)																																																		
Aug.	5	4	1 (Net Profit)																																																		
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**Strand: Statistics and Probability (Data Analysis)****Students will:**

- collect, display and analyze data to make predictions about a population.

[C] Communication [PS] Problem Solving  
[CN] Connections [R] Reasoning  
[E] Estimation and [T] Technology  
Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>1.3 The map below shows the atmospheric pressure, measured in hectopascals, forecast at various weather stations for June 3, 1996. A current Environment Canada map can be found on the Internet at: <a href="http://www.cmc.doe.ca/cmc/images/charts/125_100.gif">http://www.cmc.doe.ca/cmc/images/charts/125_100.gif</a></p>  <p>From Environment Canada, on line, June 2, 1996, with permission.</p> <ol style="list-style-type: none"><li>Using a current map, estimate the forecasted atmospheric pressure at your location.</li><li>What is the lowest pressure recorded in Canada for the date on your map?</li><li>What is the highest pressure recorded in Canada for the date on your map?</li><li>Shaded areas show where rain is falling. What connection is there between atmospheric pressure and rainfall?</li></ol>



**Strand:** Statistics and Probability (Data Analysis)

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[C] Communication

[CN] Connections

[E] Estimation and

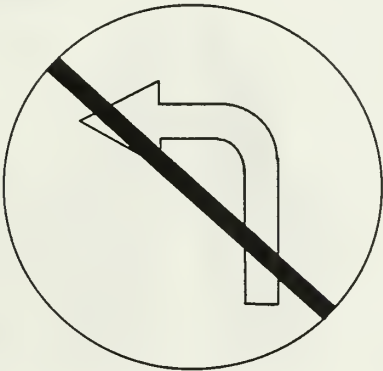
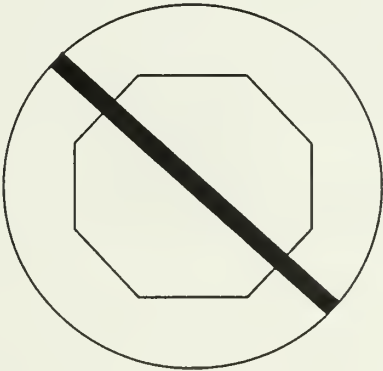
Mental Mathematics

[PS] Problem Solving

[R] Reasoning

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>1.4 Pictorial road signs, as used in Canada and most other countries, are examples of glyphs. They use shapes and sizes to convey the type of sign; then levels of symbols are used to convey meaning. Thus, the sign for <i>no left turn</i>, shown in the diagram below, is a two-level glyph that has a circular shape, a left turn arrow and a bar through the arrow.</p>  <p>a) What does the circular shape represent? b) What does the bar mean? c) What is the meaning of the sign below, and how is the meaning conveyed?</p>  <p>d) Design a three-level glyph for <i>no right turn for trucks</i>. Why is there no such sign in provincial operator manuals?</p>



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General and Specific Outcomes	Illustrative Examples [Discretionary]
A4-2. Draw and validate inferences, including interpolations and extrapolations, from graphical and tabular data. [CN, E, PS, V]	<p>2.1 The bar graph below shows the projected Canadian population, by age group, for the period from 1992 to 2036.</p> <p><b>Projected population, by age group, 1992 to 2036</b> CST</p> <p>Source: Statistics Canada, Demography Division, unpublished data, projection 3 modified to use T.F.R. of 1.84, annual immigration of 250,000, annual emigration of 86 886.</p> <p>Reproduced by authority of the Minister of Industry, 1998, Statistics Canada, <i>Canadian Social Trends</i>, Catalogue 11-008E, Number 29 Summer 1993, p. 6.</p> <p>a) What year is Canada's population expected to reach 30 million? b) Describe the rate of increase of Canada's population, both overall and by age group. c) Estimate the median age of the Canadian population in 1992 and in 2036. d) Estimate when Canada's population will reach 40 million.</p>

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[C] Communication

[PS] Problem Solving

[CN] Connections

[R] Reasoning

[E] Estimation and

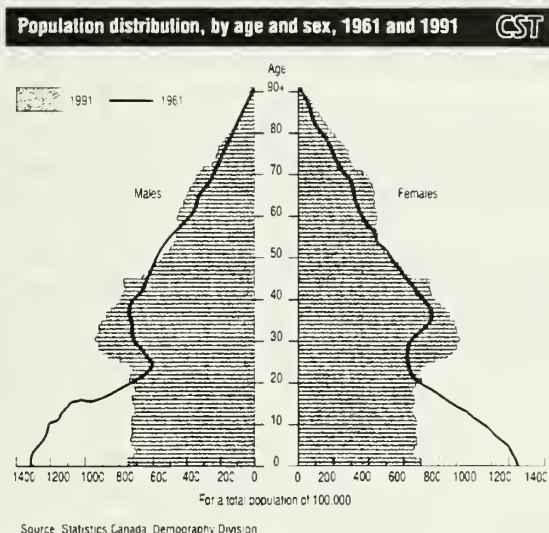
[T] Technology

Mental Mathematics

[V] Visualization

**General and Specific Outcomes****Illustrative Examples [Discretionary]**

- 2.2 The population pyramids shown below are for Canada for 1961 and 1991. Separate data are shown for males and females.



Reproduced by authority of the Minister of Industry, 1998, Statistics Canada, *Canadian Social Trends*, Catalogue 11-008E, Number 29 Summer 1993, p. 6.

- What is the approximate ratio of male births to female births? Has this ratio changed from 1961 to 1991? Describe any change, and make a hypothesis for the change.
- The baby boom was a period of time that was characterized by a greater number of births than in the years before or after. What evidence is there for a baby boom, and what were the years of the baby boom?
- The birth rate was low during the years of the Depression (1931–39) and World War II (1939–45). Where is there evidence for this?
- The shapes of the population pyramids, especially the 1961 pyramid, show a marked lack of symmetry between the data for males and the data for females. Identify where the lack of symmetry is greatest, and make hypotheses for the lack of symmetry. How could these hypotheses be tested?
- Sketch a population pyramid for the year 2011, identifying any assumptions made. Use the graph from illustrative example 2.1 as necessary.

**Strand:** Statistics and Probability (Data Analysis)

*Students will:*

- collect, display and analyze data to make predictions about a population.

[C] Communication

[CN] Connections

[E] Estimation and

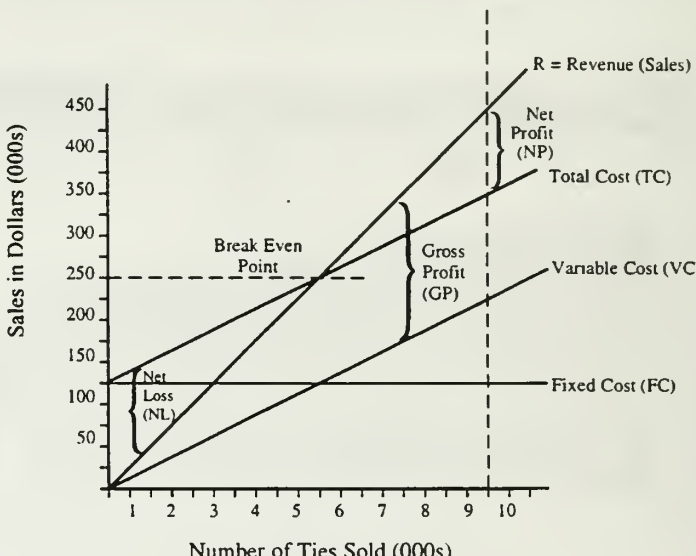
Mental Mathematics

[PS] Problem Solving

[R] Reasoning

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>2.3 BREAK EVEN ANALYSIS</p>  <p>A small store in a shopping mall sells neckties for \$50 each. The ties cost the merchant \$25 each. Yearly operating expenses, such as wages, rent, utilities and insurance, are \$125 000.</p> <p><math>VC + FC = TC</math>, <math>R - VC = GP</math>, <math>GP - FC = NP</math>,  <math>R - TC = NP</math> (or <math>NL</math>)</p> <p>If the store sold 100 ties, the sales (R) would not pay for the expenses; therefore, the store would be losing money. At \$250 000 in sales, the store's sales just cover all the cost of the goods sold (VC) and expenses (FC). Therefore, the store just breaks even. If the store sells 9000 ties in a year:</p> <ol style="list-style-type: none"> <li>What is the net profit?</li> <li>What is the gross profit?</li> <li>What is the fixed cost?</li> </ol>

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[C] Communication [PS] Problem Solving  
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Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
A4–3. Design different ways of presenting data and analyzing results, by focusing on the truthful display of data and the clarity of presentation. [C, CN, T, V]	<p>3.1 Collect an example from a newspaper or magazine in which a graph has been presented in a potentially deceptive manner. Identify the source from which the graph was taken. Explain briefly the ways in which the graph might have been deceptively presented and then show ways the data might be presented more fairly or in a less distorted fashion. Include the graph with the project, and cite its source.</p> <p>Excerpted and adapted with permission from <i>Data Analysis and Statistics (Curriculum and Evaluation Addenda Series, Grades 9–12)</i>, copyright 1992 by the National Council of Teachers of Mathematics. All rights reserved.</p> <p>3.2 Using data for 10-year intervals, as provided in Canada's Population table on the following page, starting in 1921 and ending in 1991, design an honest presentation of the data that can be included in different term papers dealing with each of the following topics:</p> <ol style="list-style-type: none"><li>a) the increase in Canada's population</li><li>b) the westward shift of Canada's population</li><li>c) the population of Saskatchewan</li><li>d) the dominant position of Ontario and Quebec within Canada.</li></ol> <p>Explain your choice of data selection and data presentation.</p>



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 Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]							
	Canada's Population <sup>1</sup> (Thousands)							
		Nfld.	PEI	NS	NB	Que.	Ont.	Man.
	1921		88.6	523.8	387.9	2,360.5	2,933.7	610.1
	1931		88.0	512.8	408.2	2,874.7	3,431.7	700.1
	1941		95.0	578.0	457.4	3,331.9	3,787.7	729.7
	1951	361.4	98.4	642.6	515.7	4,055.7	4,597.6	776.5
	1956	415.1	99.3	694.7	554.6	4,628.4	5,404.9	850.0
	1961	457.9	104.6	737.0	597.9	5,259.2	6,236.1	921.7
	1966	493.4	108.5	756.0	616.8	5,780.8	6,960.9	963.1
	1971	522.1	111.6	789.0	634.6	6,027.8	7,703.1	988.2
	1976	557.7	118.2	828.6	677.3	6,234.5	8,264.5	1,021.5
	1981	567.7	122.5	847.4	696.4	6,438.2	8,624.7	1,026.2
	1986	568.3	126.6	873.2	710.4	6,540.2	9,113.0	1,071.2
	1987 <sup>2</sup>	568.1	127.3	878.0	712.3	6,592.6	9,265.0	1,079.0
	1988 <sup>2</sup>	568.8	128.5	881.9	714.3	6,640.8	9,431.1	1,084.1
	1989 <sup>2</sup>	571.1	129.9	888.3	717.8	6,698.2	9,589.6	1,086.3
	1990 <sup>2</sup>	572.7	130.7	895.1	722.6	6,768.2	9,749.6	1,089.0
	1991 <sup>2</sup>	575.7	131.2	901.0	727.6	6,847.4	9,917.3	1,094.4
	1992 <sup>3</sup>	577.5	130.5	906.3	729.3	6,925.2	10,098.6	1,096.8
			Sask.	Alta.	BC	YT	NWT	Canada
	1921		757.5	588.5	524.6	4.1	8.1	8,787.4
	1931		921.8	731.6	694.3	4.2	9.3	10,376.7
	1941		896.0	796.2	817.8	5.0	12.0	11,506.7
	1951		831.7	939.5	1,165.2	9.1	16.0	14,009.4
	1956		880.7	1,123.1	1,398.5	12.2	19.3	16,080.8
	1961		952.2	1,332.0	1,629.1	14.6	23.0	18,265.3
	1966		955.4	1,463.2	1,873.7	14.4	28.7	20,014.9
	1971		926.2	1,627.9	2,184.6	18.4	34.8	21,568.3
	1976		921.3	1,838.0	2,466.6	21.8	42.6	22,992.6
	1981		968.3	2,237.3	2,744.2	23.2	45.7	24,341.7
	1986		1,010.2	2,375.1	2,889.0	23.5	52.2	25,353.0
	1987 <sup>2</sup>		1,015.8	2,377.7	2,925.0	24.5	52.0	25,617.3
	1988 <sup>2</sup>		1,013.5	2,388.7	2,980.2	25.2	52.2	25,909.2
	1989 <sup>2</sup>		1,006.7	2,425.9	3,048.3	25.5	52.9	26,240.3
	1990 <sup>2</sup>		997.1	2,473.1	3,132.5	26.0	53.9	26,610.4
	1991 <sup>2</sup>		994.2	2,521.6	3,212.1	26.7	55.2	27,004.4
	1992 <sup>3</sup>		993.2	2,562.7	3,297.6	27.9	56.5	27,402.1
1. As of June 1.				Sources				
2. Final postcensal estimates.				Employment and Immigration Canada				
3. Updated postcensal estimates.				Statistics Canada				
Reproduced by authority of the Minister of Industry, 1998, Statistics Canada, Canada Year Book 1994, Catalogue No. 11-402E/1994, p. 112.								



**Strand:** Number (Number Operations)

*Students will:*

- demonstrate an understanding of and proficiency with calculations
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[C] Communication

[CN] Connections

[E] Estimation and  
Mental Mathematics

[PS] Problem Solving

[R] Reasoning

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General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Describe and apply operations on matrices to solve problems, using technology as required.</p> <p><b>Specific Outcomes</b></p> <p>A6–1. Show an understanding of matrices and perform the operations of addition, scalar multiplication and matrix multiplication. [C, T]</p>	<p>1.1 Calculate each of the following:</p> <p>a) <math>\begin{pmatrix} 4 &amp; 6 \\ 2 &amp; -1 \end{pmatrix} + \begin{pmatrix} 3 &amp; 8 \\ 2 &amp; -5 \end{pmatrix}</math>    b) <math>4 \begin{pmatrix} 2 &amp; 3 &amp; -4 \\ 1 &amp; 0 &amp; 5 \end{pmatrix}</math>    c) <math>\begin{pmatrix} 3 &amp; 2 \\ -1 &amp; 4 \end{pmatrix} \begin{pmatrix} 4 &amp; 1 &amp; -2 \\ 3 &amp; 5 &amp; 0 \end{pmatrix}</math>.</p> <p>1.2 Represent a real-world situation, using a matrix.</p> <p>a) For towns participating in a local hockey league, create hockey standings, including home, away and combined records.</p> <p>b) Diagram various networking strategies, such as those found in an office, in a telephone system, in a roadway system.</p> <p>1.3 Singh's Grocery sells several different kinds of breakfast cereal, each at a different price.</p> <p>Cereal A is 2.65/bx. Cereal B is 3.73/bx. Cereal C is 3.15/bx. Cereal D is 2.99/bx.</p> <p>Write the price list as a row matrix.</p> <p>On Wednesday, they sold the following:</p> <p>5 boxes of Cereal A 8 boxes of Cereal B 7 boxes of Cereal C 10 boxes of Cereal D.</p> <p>Write Wednesday's sales as a column matrix. Use matrix multiplication to find Wednesday's total revenues.</p>

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[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[E] Estimation and Mental Mathematics	[T] Technology
	[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]												
A6-2. Solve problems, using the operations of addition, subtraction, scalar multiplication and matrix multiplication on matrices. [PS, R, T, V]	<div>2.1 A store sells items that are tax-free, items that have a 7% GST charge on the base price and items that have both a 7% GST and a 9% PST charge on the base price. A weekend's sales, before tax, can be represented by:</div> <div><table><tr><td></td><td>Saturday</td><td>Sunday</td></tr><tr><td>Tax free</td><td>500</td><td>700</td></tr><tr><td>GST only</td><td>1250</td><td>400</td></tr><tr><td>GST and PST</td><td>800</td><td>700</td></tr></table><math display="block">S = \begin{pmatrix} 500 &amp; 700 \\ 1250 &amp; 400 \\ 800 &amp; 700 \end{pmatrix}</math></div> <div>a) What does the matrix <math>A = \begin{pmatrix} 0 &amp; 0 \\ 1250 &amp; 400 \\ 800 &amp; 700 \end{pmatrix}</math> represent?</div> <div>b) What does the matrix <math>B = \begin{pmatrix} 0 &amp; 0 \\ 0 &amp; 0 \\ 800 &amp; 700 \end{pmatrix}</math> represent?</div> <div>c) What does the matrix <math>(S + 0.07A + 0.09B)</math> represent?</div> <div>d) Write a matrix to represent the total tax collected. What are the entries for this matrix?</div> <div>e) Budgets change the tax rates to 5% for GST and 12% for PST. Write a new matrix for the total taxes collected in this new situation. What are the entries for this new matrix?</div> <div>2.2 Sales of economy cars were 200 in 1993 and rose by 3% in 1994. Sales of midsize cars were 300 in 1993 and rose by 10% in 1994. Sales of luxury cars were 40 in 1993 and fell by 5% in 1994. Show that 1994 sales can be represented by the matrix multiplication shown.</div> <div><math display="block">\begin{pmatrix} 1.03 &amp; 0 &amp; 0 \\ 0 &amp; 1.10 &amp; 0 \\ 0 &amp; 0 &amp; 0.95 \end{pmatrix} \begin{pmatrix} 200 \\ 300 \\ 40 \end{pmatrix} = \begin{pmatrix} 206 \\ 330 \\ 38 \end{pmatrix}</math></div>		Saturday	Sunday	Tax free	500	700	GST only	1250	400	GST and PST	800	700
	Saturday	Sunday											
Tax free	500	700											
GST only	1250	400											
GST and PST	800	700											

**Strand: Number (Number Operations)****Students will:**

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[C] Communication [PS] Problem Solving  
 [CN] Connections [R] Reasoning  
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 Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]																									
	<p>2.3 Soccer has been experimenting with using league standings to discourage tie games, especially those with no goals. The traditional scheme of 2 points for a win and 1 point for any tie has been replaced by 3 points for a win and 1 point for any tie. Proposed schemes have included 3 points for a win, 1 point for ties that have goals scored and 0 points for ties with no goals; as well as a scheme with 5 points for a win, 3 points for a tie with goals scored and 0 points for a tie with no goals. In a local soccer league the top four team records after 42 games are:</p> <table><tr><td></td><td>Wins</td><td>Ties with Goals</td><td>Ties with no Goals</td><td>Losses</td></tr><tr><td>Tigers</td><td>30</td><td>2</td><td>8</td><td>2</td></tr><tr><td>Irish</td><td>24</td><td>9</td><td>2</td><td>7</td></tr><tr><td>Colts</td><td>25</td><td>7</td><td>0</td><td>10</td></tr><tr><td>Jets</td><td>26</td><td>1</td><td>10</td><td>5</td></tr></table> <p>a) Multiply the matrix above by <math>\begin{pmatrix} 2 \\ 1 \\ 1 \\ 0 \end{pmatrix}</math> to get the traditional points.</p> <p>b) Multiply the matrix above by <math>\begin{pmatrix} 3 \\ 1 \\ 1 \\ 0 \end{pmatrix}</math>, by <math>\begin{pmatrix} 3 \\ 1 \\ 0 \\ 0 \end{pmatrix}</math> and by <math>\begin{pmatrix} 5 \\ 3 \\ 0 \\ 0 \end{pmatrix}</math> to get the points under the alternative systems.</p> <p>c) Which of the alternative scoring systems can make the Irish second in the standings?</p> <p>d) Which of the alternative scoring systems can make the Colts second in the standings?</p> <p>e) Which of the alternative scoring systems can make the Jets second in the standings?</p> <p>f) Design a system that would drop the Tigers out of first place. Is it a fair system?</p>		Wins	Ties with Goals	Ties with no Goals	Losses	Tigers	30	2	8	2	Irish	24	9	2	7	Colts	25	7	0	10	Jets	26	1	10	5
	Wins	Ties with Goals	Ties with no Goals	Losses																						
Tigers	30	2	8	2																						
Irish	24	9	2	7																						
Colts	25	7	0	10																						
Jets	26	1	10	5																						

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[C] Communication

[PS] Problem Solving

[CN] Connections

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[T] Technology

Mental Mathematics

[V] Visualization

**General and Specific Outcomes****Illustrative Examples [Discretionary]**

- 2.4 Diplomacy in the Asia-Pacific region is complicated by different alliances. The exchange of diplomats in 1996 can be represented by the matrix  $D$ , where:

$$D = \begin{matrix} & \begin{matrix} \text{NK} & \text{SK} & \text{Ch} & \text{T} & \text{Can} \end{matrix} \\ \begin{matrix} \text{North Korea} \\ \text{South Korea} \\ \text{China} \\ \text{Taiwan} \\ \text{Canada} \end{matrix} & \begin{pmatrix} 0 & 0 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 0 & 1 \\ 0 & 1 & 0 & 0 & 0 \\ 0 & 1 & 1 & 0 & 0 \end{pmatrix} \end{matrix}$$

An entry of 1 represents an exchange of ambassadors; an entry of 0 represents no exchange of ambassadors.

- a) Draw a network diagram to represent the matrix.

Powers of the matrix  $D$  represent the number of diplomatic channels available for the exchange of data. The matrix  $D^2$  represents channels with one intermediary, matrix  $D^3$  represents channels with two intermediaries, and matrix  $D^4$  represents channels with three intermediaries. The channels can be listed after the number of channels are identified.

- b) Verify that the matrix  $D^2$  is given by:

$$\begin{pmatrix} 1 & 0 & 0 & 0 & 1 \\ 0 & 2 & 1 & 0 & 0 \\ 0 & 1 & 2 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 \\ 1 & 0 & 0 & 1 & 2 \end{pmatrix}$$

Explain why there are no zero entries along the diagonal between top left and bottom right.

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[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[E] Estimation and Mental Mathematics	[T] Technology
	[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>c) Verify that <math>D^3</math> is the matrix:</p> $\begin{pmatrix} 0 & 1 & 2 & 0 & 0 \\ 1 & 0 & 0 & 2 & 3 \\ 2 & 0 & 0 & 1 & 3 \\ 0 & 2 & 1 & 0 & 0 \\ 0 & 3 & 3 & 0 & 0 \end{pmatrix}$ <p>Trace the channel between China and Taiwan.</p> <p>d) The matrix <math>D^4</math> is given by:</p> $\begin{pmatrix} 2 & 0 & 0 & 1 & 3 \\ 0 & 5 & 4 & 0 & 0 \\ 0 & 4 & 5 & 0 & 0 \\ 1 & 0 & 0 & 2 & 3 \\ 3 & 0 & 0 & 3 & 6 \end{pmatrix}$ <p>Trace out the path that a message would take to go from North Korea to Taiwan, using three intermediaries.</p> <p>e) The matrix <math>D + D^2 + D^3</math> is given by:</p> $\begin{pmatrix} 1 & 1 & 3 & 0 & 1 \\ 1 & 2 & 1 & 3 & 4 \\ 3 & 1 & 2 & 1 & 4 \\ 0 & 3 & 1 & 1 & 1 \\ 1 & 4 & 4 & 1 & 2 \end{pmatrix}$ <p>This matrix represents all those channels that need two or fewer intermediaries. Trace out the one channel between Canada and Taiwan and all four channels between Canada and South Korea.</p>



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[C] Communication [PS] Problem Solving  
[CN] Connections [R] Reasoning  
[E] Estimation and [T] Technology  
Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
A6–3. Use matrices and matrix operations to model and to solve consumer, network and schedule problems. [C, CN, PS, R, T, V]	<p>3.1 A washing powder is sold in 6 L and 10 L packages. Market research shows that 7% of the users of the 6 L size switch to the 10 L size for their next purchase, and 3% of the users of the 10 L size switch to the 6 L size for their next purchase.</p> <p>a) If the original market share was 60% for 6 L and 40% for 10 L, what is the market share for each size in the next round of purchases?</p> <p>b) What is the market share for each size for the third round of purchases?</p> <p>c) Rewrite the processes for a) and b) in terms of a <math>2 \times 2</math> transition matrix and a <math>2 \times 1</math> market share matrix.</p> <p>d) What would be the final market share?</p> <p>e) Use iteration to estimate how quickly the final market share for each size is approached.</p> <p>3.2 A car manufacturer makes three models of car: full size, compact and economy. Of full size car buyers, 13% will switch to compact and 2% to economy. Of compact car buyers, 5% will switch to full size and 4% to economy. Of economy car buyers, 21% will switch to compact and 3% to full size.</p> <p>a) If the initial market share is 30% full size, 20% compact and 50% economy, what is the market share for each model for the next round of purchases?</p> <p>b) What is the market share for each model for the third round of purchases?</p> <p>c) Write a <math>3 \times 3</math> matrix <math>T</math> that represents the switching behaviour.</p> <p>d) Find the final market share for each model.</p>

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General and Specific Outcomes	Illustrative Examples [Discretionary]																																																													
<p><b>General Outcome</b></p> <p>Design or use a spreadsheet to make and justify financial decisions.</p> <p><b>Specific Outcomes</b></p> <p>A8–1. Design or modify a financial spreadsheet template to allow users to input their own variables. [C, PS, T]</p>	<p>1.1 For the following invoice, develop a spreadsheet that calculates the totals and that requires the operator to input a minimum number of entries.</p> <p style="text-align: center;"><b>ACME AUTO PARTS</b></p> <p><u>Customer Inquiries</u></p> <table><tr><th>Item No.</th><th>Auto Parts</th><th>Quantity</th><th>Unit Price</th><th>Total</th><th colspan="2">Labour</th></tr><tr><td>1</td><td>Brake Pads</td><td>1</td><td>26.34</td><td>26.34</td><td>O/H Front Brakes 1.5 hrs. @ 37.00/hr.</td><td>51.25</td></tr><tr><td>2</td><td>Wheel Seals</td><td>2</td><td>5.25</td><td>10.50</td><td rowspan="2">Machined and Replaced Rotor</td><td rowspan="2">10.00</td></tr><tr><td>3</td><td>Rotor</td><td>1</td><td>30.16</td><td>30.16</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td>Total Labour</td><td>61.25</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td>Total Parts</td><td>67.00</td></tr><tr><td></td><td colspan="3">Total Parts</td><td>67.00</td><td>PST on Parts (8%)</td><td>5.36</td></tr><tr><td></td><td colspan="3"></td><td></td><td>GST (7%)</td><td>8.98</td></tr><tr><td></td><td colspan="3"></td><td></td><td>TOTAL</td><td>142.59</td></tr></table>	Item No.	Auto Parts	Quantity	Unit Price	Total	Labour		1	Brake Pads	1	26.34	26.34	O/H Front Brakes 1.5 hrs. @ 37.00/hr.	51.25	2	Wheel Seals	2	5.25	10.50	Machined and Replaced Rotor	10.00	3	Rotor	1	30.16	30.16						Total Labour	61.25						Total Parts	67.00		Total Parts			67.00	PST on Parts (8%)	5.36						GST (7%)	8.98						TOTAL	142.59
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[E] Estimation and Mental Mathematics	[T] Technology
	[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
A8-2. Use spreadsheets to analyze renting or buying an increasing asset (home) under different sets of circumstances. [C, PS, T]	<p>2.1 The Wong family is faced with a move and has the choice of buying a home for \$145 000 with a \$25 000 down payment, or renting a similar house for \$975 per month. Four options are available.</p> <ol style="list-style-type: none"><li>1. Buy the house with a 20-year mortgage and continue investing at the same rate after the mortgage is paid.</li><li>2. Buy the house with a 30-year mortgage.</li><li>3. Rent a house and invest the \$25 000.</li><li>4. Rent a house and invest both the \$25 000 and the difference each month between the rent and the mortgage payment.</li></ol> <p>The analysis spreadsheets must include the following inputs:</p> <ol style="list-style-type: none"><li>a) mortgage interest rate, taking 8.5% as a starting value</li><li>b) taxation rate, taking 1.5% of market value as a starting value</li><li>c) annual rent increase, taking 5% per annum as a starting value</li><li>d) annual increase in house value, taking 4% per annum as a starting value</li><li>e) investment return, taking 7.0% as a starting value.</li></ol> <p>Try different scenarios, varying from 1 year to 30 years. Summarize circumstances in which buying makes sense, and summarize circumstances when renting makes sense.</p>
A8-3. Use spreadsheets to analyze leasing or buying a decreasing asset (vehicle, computer) under different sets of circumstances. [C, PS, T]	<p>3.1 A car lease runs for 36 months at \$305 per month, with a down payment of \$1105, a lease-end value of \$7105 and an interest rate of 11.6%. Maintenance is the purchaser's responsibility. Set up a spreadsheet to include the monthly values of the opening balance, interest paid, lease payment and closing balance. Use the spreadsheet to answer the following questions.</p> <ol style="list-style-type: none"><li>a) What part of the \$305 is used to pay the interest on the \$7105?</li><li>b) What total price is being charged for the car?</li><li>c) What is the change in the monthly lease payment, if the lease-end value is reduced to \$5700?</li><li>d) What is the monthly payment for a straight purchase over 36 months with a 20% down payment?</li><li>e) What is the annual percentage depreciation rate assumed with the \$7105 lease-end value?</li></ol>

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General and Specific Outcomes	Illustrative Examples [Discretionary]
A8-4. Use spreadsheet(s) to analyze an investment or life insurance portfolio, applying such concepts as capital gains, interest rate, inflation rate, risk, total rate of return and after-tax rate of return. [C, PS, T]	<p>4.1 The time needed for an investment to double in value can be estimated using the rule of 72, which states that <math>n = \frac{72}{i}</math> where <math>i</math> is the annual percentage interest rate and <math>n</math> the number of years.</p> <p>a) Compare the rule of 72 doubling time with the exact doubling time for the following interest rates:</p> <ul style="list-style-type: none"> <li>• 4% per annum, compounded annually</li> <li>• 8% per annum, compounded annually</li> <li>• 24% per annum, compounded annually.</li> </ul> <p>b) What general conclusion can be drawn as to the accuracy of rule of 72 calculations?</p> <p>4.2 An average car in 1996 costs \$20 000.</p> <p>a) If this money were invested for 15 years at 8% per year, compounded yearly, and cars did not increase in price, how many cars could be bought in 2011?</p> <p>b) If the average inflation rate were 3.5% per year, how many cars could be bought in 2011 with the proceeds from the investment?</p> <p>c) What is the real, after inflation, rate of return for the investment?</p> <p>d) How do the answers change, if 40% of the interest is taken in income tax every year?</p> <p>4.3 A retirement portfolio of \$300 000 is to be invested for a 10-year period. A middle-risk stock has a probability of 0.80 of making a 110% capital gain and paying annual dividends of 3.2%; there is a 0.20 probability of making a 30% capital loss and paying no annual dividends. Term deposits are guaranteed to pay interest at 7.5% per year, compounded annually.</p> <p>a) What is the best net worth, if all the capital is invested in stocks and the stocks make the maximum capital gain?</p> <p>b) What is the worst net worth, if all the capital is invested in stocks and the stocks take the maximum capital loss?</p> <p>c) Compare the expected net worth from the stocks to the guaranteed net worth from the term deposits.</p> <p>d) How would the numbers in the problem be different for high-risk stocks and for low-risk stocks?</p> <p>e) Modify the calculations to allow for 40% of the gains to be paid yearly in income tax.</p>



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[C] Communication

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Mental Mathematics

[PS] Problem Solving

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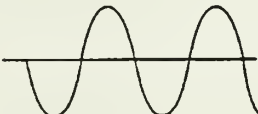
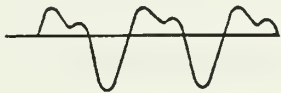
General and Specific Outcomes	Illustrative Examples [Discretionary]
A8–5. Analyze car or house insurance needs and premiums, using such concepts as loss, probability of loss, compulsory coverage, optional coverage, deductible and claims record. [CN, E, R, T]	<p>5.1 Obtain collision damage figures for inexperienced drivers and for experienced drivers from an insurance company, and then calculate a fair insurance premium for \$1 000 000 liability, \$250 deductible collision and \$100 deductible comprehensive theft/glass coverage. Do the calculation twice, once for each type of driver.</p> <p>What change in premium would be fair, if the deductible for collision were raised to \$1000?</p> <p>5.2 At what point is it worth it to drop collision coverage on an older vehicle? Show a strategy, and explain the supporting calculations.</p> <p>5.3 How long does a home security system need to be installed before the cost of the system is paid for by the savings in insurance premiums? Obtain data for your area from an insurance agent. Show a strategy, and explain the supporting calculations.</p>



**Strand:** Patterns and Relations (Patterns)*Students will:*

- use patterns to describe the world and to solve problems.

[C] Communication [PS] Problem Solving  
 [CN] Connections [R] Reasoning  
 [E] Estimation and [T] Technology  
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General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Generate and analyze cyclic, recursive and fractal patterns.</p> <p><b>Specific Outcomes</b></p> <p>A7-1. From cyclic data produce a periodic graph. [C, PS, V]</p> <p>A7-2. Predict results from graphs that represent periodic events. [E, R, V]</p>	<p>1.1 Research the sunrise time for a period of one year, and graph it. From your graph, determine the time of sunrise for March 12.</p> <p>2.1 The following are graphs showing the patterns produced on an oscilloscope when four different musical instruments are played.</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>violin</p> </div> <div style="text-align: center;">  <p>clannet</p> </div> </div> <div style="display: flex; justify-content: space-around; align-items: flex-end;"> <div style="text-align: center;">  <p>tuning fork</p> </div> <div style="text-align: center;">  <p>organ pipe</p> </div> </div> <p>From <i>Fundamentals of Physics</i> by Martindale et al. Reprinted by permission of ITP Nelson Canada.</p> <p>For each instrument:</p> <ol style="list-style-type: none"> <li>find the amplitude</li> <li>find the period</li> <li>sketch the graph, if the instrument is played louder</li> <li>sketch the graph, if the instrument is used to play a higher note.</li> </ol>

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General and Specific Outcomes	Illustrative Examples [Discretionary]
<p>A7-3. Describe periodic events, including sinusoidal curves, using correct terminology. [C, V]</p>	<p>3.1 A temperature–time graph was drawn for a northern Saskatchewan town. The variable plotted on the horizontal axis is the calendar date, with April 1 as zero and the unit being days. The variable plotted on the vertical axis is the temperature in degrees Celsius. The graph is drawn below. Find the:</p> <ol style="list-style-type: none"><li>a) amplitude</li><li>b) period</li><li>c) maximum and minimum values</li><li>d) vertical shift</li><li>e) date for the maximum temperature</li><li>f) date for the minimum temperature.</li></ol> <p style="text-align: center;">(85, 15)</p> <p style="text-align: center;">(-100, -30)</p>
<p>A7-4. Collect sinusoidal data; sketch the graph of the data; and, using degrees, represent the data with an equation of the form:</p> <ul style="list-style-type: none"><li>• <math>y = a \sin(kt) + c</math></li></ul> <p style="text-align: center;"><b>OR</b></p> <ul style="list-style-type: none"><li>• <math>y = a \cos(kt) + c</math>.</li></ul> <p>[CN, PS, T, V]</p>	<p>4.1 Collect data from real-world situations, such as:</p> <ol style="list-style-type: none"><li>a) hours of daylight</li><li>b) low tide and high tide</li><li>c) average low and average high temperatures on different dates of the year.</li></ol> <p>Plot the data, and determine an approximate equation for the data in the form of: <math>y = a \sin(kt) + c</math> or <math>y = a \cos(kt) + c</math>.</p>

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Mental Mathematics

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
A7-5. Develop sinusoidal equations, using degrees, to represent periodic behaviour. [CN, PS, T]	5.1 Sketch a graph, and build an equation to represent the following situation.  The average daily maximum temperature in Vancouver follows a sinusoidal pattern with a highest value of 24°C and a lowest value of 8°C. The highest value occurs on July 15 and the lowest value on January 15.
A7-6. Use technology to generate and graph finite or infinite sequences whose recursive definition may or may not be given. [PS, T, V]	6.1 For the Fibonacci sequence 1, 1, 2, 3, 5, . . . , determine a recursive form.  6.2 Find the 20 <sup>th</sup> term of the sequence $t_n = t_{n-1} + 2$ , where $t_1 = 1$ , by generating a table or graph.  6.3 A sequence is defined by $t_n = 3t_{n-1} + 2t_{n-2}$ . Determine the value of $t_9$ , given $t_0 = 5$ and $t_1 = 3$ . Use a spreadsheet to find $t_{100}$ and the first term of the sequence that has a value of more than 1 million.
A7-7. Identify sequences that appear to be: <ul style="list-style-type: none"> <li>• divergent</li> <li>• convergent</li> <li>• oscillating</li> <li>• static.</li> </ul> [C, V]	7.1 Calculate several terms of the following sequences where the $n^{\text{th}}$ term is defined as follows: <ul style="list-style-type: none"> <li>a) <math>a_n = 6^{n+1}</math></li> <li>b) <math>a_n = (-2)^n</math></li> <li>c) <math>a_n = 6</math></li> <li>d) <math>a_n = \frac{1}{2n}</math></li> </ul> <p>Graph the results. Use this information to hypothesize each of the sequences as divergent, convergent, oscillating or static.</p> 7.2 The monthly closing balances of a loan form a sequence. Under what conditions will these balances form a divergent sequence?  7.3 Regular polygons of $n$ sides are inscribed in a circle of radius 10 cm. The perimeters $P_n$ of these regular polygons form a sequence. Is this sequence convergent? Estimate the value of $P_n$ , if $n$ is very large.

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[C] Communication

[PS] Problem Solving

[CN] Connections

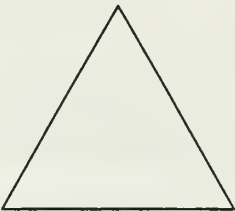
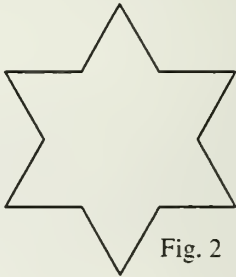
[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

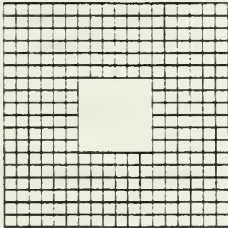
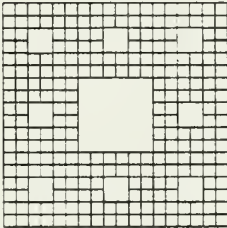
[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p>A7–8. Construct a fractal pattern by repeatedly applying a procedure to a geometric figure. [CN, R, V]</p>	<p>8.1 The following example is the Koch snowflake curve. Construct an equilateral triangle (Fig. 1). Trisect each side, construct an equilateral triangle on each middle third, and delete the middle third (Fig. 2).</p> <div style="display: flex; justify-content: space-around; align-items: center;"><div style="text-align: center;"> Fig. 1</div><div style="text-align: center;"> Fig. 2</div></div> <p>For each segment in Fig. 2, repeat the above.</p> <p>8.2 Construct your own fractal pattern.</p>
<p>A7–9. Use the concept of self-similarity to compare and/or predict the perimeters, areas and volumes of fractal patterns. [CN, R, V]</p>	<p>9.1 For illustrative example 8.1, predict the perimeter of the fifth pattern.</p>

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[C]	Communication	[PS]	Problem Solving
[CN]	Connections	[R]	Reasoning
[E]	Estimation and Mental Mathematics	[T]	Technology
		[V]	Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>9.2 Fractal Carpet</p> <p>A fractal can be generated by a pattern of iteration. This fractal design is called the Sierpinski carpet after the mathematician who invented it in 1916. The general rule is to start with a square and take a square out. Look at the first iteration and describe the rule that was used to determine the size of the square that was removed. Now compare the first two iterations and describe the rule that was used to construct the second from the first. Apply the rule you have stated to construct the third iteration in the space provided.</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;"><div style="text-align: center;"><p>Iteration 1</p></div><div style="text-align: center;"><p>Iteration 2</p></div><div style="text-align: center;"><p>Iteration 3</p></div></div> <p>Now examine the third iteration you have constructed, and record the length of the side of the new squares you drew. Compare this length to the lengths of the sides of the previous squares. Write the lengths of the sides of all the squares in descending order. If you construct the fourth iteration, what will the lengths of the sides of the squares need to be? Now look at the first iteration again. What is the area of the square that was removed? What is the area of each individual square that was removed in the next two iterations? Write these areas in descending order. What is the area of each individual square to be removed in the fourth iteration?</p> <p><b>Challenge:</b> Find the perimeter of all the squares in the third iteration. Find the area of the figure that remains once all the squares are removed in the third iteration.</p> <p>Excerpted and adapted with permission from <i>Geometry from Multiple Perspectives (Curriculum and Evaluation Standards Addenda Series, Grades 9–12)</i>, copyright 1991 by the National Council of Teachers of Mathematics. All rights reserved.</p>



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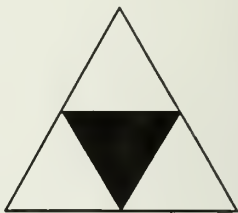
[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>9.3 The Sierpinski triangle can be created by using dilations and isometries. You may begin with an arbitrary triangle. An equilateral triangle is used for the procedures described below.</p> <ol style="list-style-type: none"> <li>Draw an equilateral triangle.</li> <li>Reduce the triangle by a factor of <math>\frac{1}{2}</math>. Make three copies of the reduced triangle.</li> <li>Place the three reduced similar triangles on the original, one at each vertex.</li> <li>Eliminate the remaining portion of the original triangle by blackening it.</li> </ol>  <p>Your work should result in the figure shown here.</p> <p>Answer the following questions:</p> <ol style="list-style-type: none"> <li>Let the area of the original triangle be 1 area unit. What area remains? What area has been removed?</li> <li>Let the side of the original triangle be 1 length unit. What is the perimeter of the figure with the dark region removed?</li> </ol> <p>Repeat steps a) through d) of the original procedure for each of the triangular regions remaining in the figure shown. Sketch the result of your work.</p> <p>Answer the following questions:</p> <ol style="list-style-type: none"> <li>What is the area of the remaining triangular region?</li> <li>What is the perimeter of the new “holey” triangular region?</li> <li>What would the next iteration of the procedure look like? Make a sketch.</li> <li>Write an expression for the area of the Sierpinski triangle after carrying out the procedure <math>n</math> times.</li> <li>Write an expression for the perimeter of the Sierpinski triangle after carrying out the procedure <math>n</math> times.</li> <li>How would your expressions differ, if you began with a triangle other than an equilateral triangle?</li> </ol> <p>Excerpted and adapted with permission from <i>Geometry from Multiple Perspectives (Curriculum and Evaluation Standards Addenda Series, Grades 9–12)</i>, copyright 1991 by the National Council of Teachers of Mathematics. All rights reserved.</p>

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General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>9.4 Construct a cylinder with the dimensions: <math>r = 10</math> cm, <math>h = 20</math> cm. A second figure is constructed by halving the previous radius and height. A third is constructed by halving the second and so on.</p> <p>a) Predict the surface area and the volume of the sixth pattern. b) Write an expression for the surface area after carrying out the procedure <math>n</math> times. c) Write an expression for the volume after carrying out the procedure <math>n</math> times.</p>

**Strand: Shape and Space (Measurement)****Students will:**

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication

[PS] Problem Solving

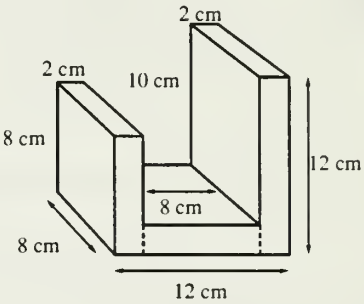
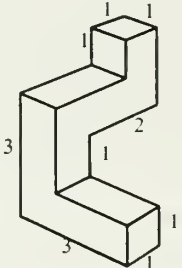
[CN] Connections

[R] Reasoning

[E] Estimation and  
Mental Mathematics

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Analyze objects, shapes and processes to solve cost and design problems.</p> <p><b>Specific Outcomes</b></p> <p>A9–1. Use dimensions and unit prices to solve problems involving perimeter, area and volume. [E, PS, V]</p>	<p>1.1 Determine the volume of the plastic book end shown below.</p>  <p>If the book end is constructed using an injection mold, find the development cost if the plastic ingredients cost 6¢ per cubic centimetre.</p> <p>1.2 In the following diagram of an outside storage system component, all the angles are right angles and the lengths are in centimetres. Find the volume.</p> <p>A special aluminum latex coating is applied to all outside surfaces of the object. What is the cost of the latex coating, if it costs 28¢ per <math>\text{cm}^2</math>?</p> 

**Strand: Shape and Space (Measurement)****Students will:**

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication

[PS] Problem Solving

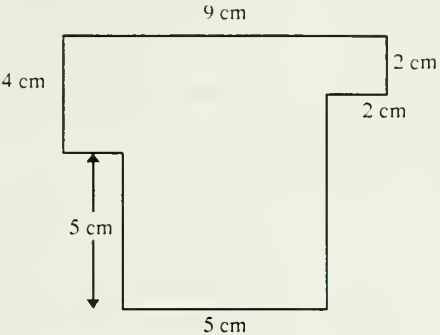
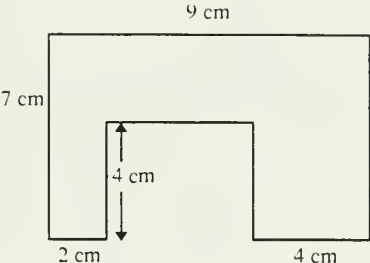
[CN] Connections

[R] Reasoning

[E] Estimation and  
Mental Mathematics

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p>A9–2. Solve problems involving estimation and costing for objects, shapes or processes when a design is given. [C, E, PS]</p>	<p>1.3 A dressmaker cuts pairs of the following shapes from a rectangular piece of gabardine that is 1 m by 0.5 m. Determine the maximum number of pairs that can be cut from the piece of gabardine. Identify any assumptions.</p> <div style="display: flex; justify-content: space-around; align-items: flex-end;">   </div> <p>2.1 A swimming pool is 50 m by 21 m. The deep end is 4.0 m deep and extends out 12 m. The shallow end is 1.2 m deep and extends out 12 m. There is a uniform slope connecting the deep and shallow ends.</p> <ol style="list-style-type: none"> <li>Draw scale diagrams showing the top view and the side view of the pool.</li> <li>Calculate the cost of filling it with water at \$2.00/m<sup>3</sup>.</li> <li>Waterproofing of the underwater surfaces costs \$17/m<sup>2</sup>. Determine the cost of waterproofing.</li> </ol> <p>2.2 A window cleaner has been asked by the owner of a large office tower to submit a quotation for cleaning the windows of the building. The window cleaner has the following information:</p> <ol style="list-style-type: none"> <li>there are 24 floors</li> <li>there are 14 windows per side on each floor</li> <li>there are 4 sides to the building.</li> </ol> <p>From experience, the window cleaner knows that the transfer time between windows on the same floor and same side of the building is 60 seconds. The transfer time between sides of the building is 120 seconds and between floors is 30 seconds. The time to clean one window is 120 seconds. The window cleaner has a base charge of \$120. The maximum period of time he works at one stretch is 3 hours, then he takes a 30 minute rest. In addition to his rate of \$25/hour, he wants to make 25% profit from the job for reinvestment in his business. What would be the best quote?</p>

**Strand: Shape and Space (Measurement)****Students will:**

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication	[PS] Problem Solving
[CN] Connections	[R] Reasoning
[E] Estimation and Mental Mathematics	[T] Technology
	[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]															
A9-3. Design an object, shape, layout or process within a specified budget. [PS, R, V]	<p>2.3 To satisfy the building code, an auditorium has to have 1200 m<sup>2</sup> of washroom space. In a washroom for males, the average space needed is 1.9 m<sup>2</sup> per user and the average usage time is 97 s. In a washroom for females, the average space needed is 2.4 m<sup>2</sup> per user and the average usage time is 145 s. Determine the required washroom space:</p> <p>a) on the basis of equal areas for males and females</p> <p>b) on the basis of equal users per hour for males and females.</p> <p>3.1 Tin plate for making cylindrical cans comes in sheets that are 240 cm by 160 cm and costs \$3.20 per sheet. Cans are 6 cm in diameter and 11 cm high, and they have 3 seals each. Seals cost 0.8¢ each to make. One sheet of tin plate is used for making pieces for ends, and two sheets are used for making pieces for sides.</p> <p>a) How many ends and how many sides can be made from the three sheets of tin plate?</p> <p>b) How many cans can be made from the three sheets, and what is the cost per can?</p> <p>c) Is there another way of making more cans from the three sheets, or the same number of cans from less tin plate?</p> <p>d) How much money is saved doing it the second way?</p> <p>3.2 To produce a voters' list for a riding, a sum of \$1.70 per voter is allocated. Four methods of enumerating are possible:</p> <table><tr><th>Method</th><th>Cost per Voter</th><th>Probability of Return</th></tr><tr><td>Hand deliver enumeration form, mail return</td><td>\$0.91</td><td>0.700</td></tr><tr><td>Mail form both ways</td><td>\$1.07</td><td>0.740</td></tr><tr><td>Telephone until voter reached</td><td>\$2.21</td><td>0.920</td></tr><tr><td>Enumerator calls until voter reached</td><td>\$5.26</td><td>0.995</td></tr></table> <p>For a total of 40 000 voters, find the maximum number of voters who can be enumerated within the budget and the minimum budget needed to be sure of enumerating 98% of the potential voters.</p> <p><b>Note:</b> This problem connects to outcomes in Applied Mathematics 30 (page 86).</p>	Method	Cost per Voter	Probability of Return	Hand deliver enumeration form, mail return	\$0.91	0.700	Mail form both ways	\$1.07	0.740	Telephone until voter reached	\$2.21	0.920	Enumerator calls until voter reached	\$5.26	0.995
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**Strand: Shape and Space (Measurement)****Students will:**

- describe and compare everyday phenomena, using either direct or indirect measurement.

[C] Communication

[PS] Problem Solving

[CN] Connections

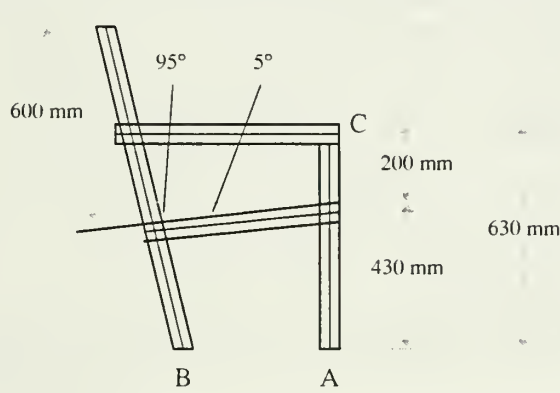
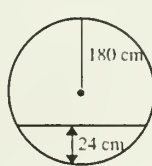
[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>3.3 One side of a wooden chair is being built. The front of the seat should be 430 mm above the ground and should slope back at <math>5^\circ</math> from the horizontal. The seat depth is 450 mm, and the angle between the seat and the back of the chair is <math>95^\circ</math>. The required length of the back of the chair, measured from the seat, is 600 mm. The height of the horizontal chair arm is 200 mm above the front of the seat. Draw a scale diagram, and use it to calculate the lengths of wooden components A, B and C. What is the maximum cost per metre for the wood needed to make this side of the chair, if the cost cannot exceed \$20?</p> 
A9-4. Use simplified models to estimate the solutions to complex measurement problems. [E, V]	<p>4.1 Estimate the area of the Yukon Territory, by:</p> <ol style="list-style-type: none"><li>counting squares</li><li>splitting the area into rectangles and triangles.</li></ol> <p>Which method is most accurate? Which type of map gives the most reliable estimate for the area of the Yukon Territory? Where are the main sources of error in the estimate?</p> <p>4.2 A water tank is a sphere of diameter 3.6 m. Estimate the volume of water in the tank, if the depth of water is 24 cm.</p> 

**Strand:** Shape and Space (3-D Objects and 2-D Shapes)

*Students will:*

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

[C] Communication

[CN] Connections

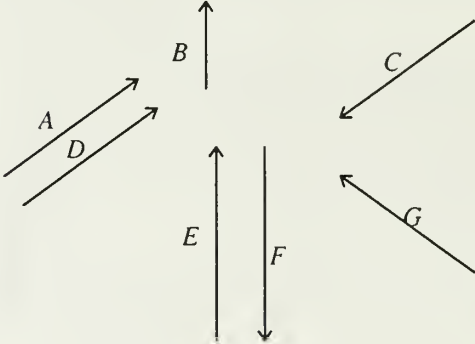
[E] Estimation and  
Mental Mathematics

[PS] Problem Solving

[R] Reasoning

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]								
<p><b>General Outcome</b></p> <p>Solve problems involving polygons and vectors, including both 3-D and 2-D applications.</p> <p><b>Specific Outcomes</b></p> <p>A6–4. Use and give 3-D and 2-D examples of vector terminology and notation, including:</p> <ul style="list-style-type: none"> <li>• vector (direction, magnitude)</li> <li>• scalar</li> <li>• unit vector</li> <li>• collinear vectors</li> <li>• opposite vectors</li> <li>• parallel vectors</li> <li>• resultant vectors.</li> </ul> <p>[C, CN]</p>	<p>4.1</p>  <p>Given the above vectors, complete the following chart.</p> <table border="1" data-bbox="722 1134 1251 1328"> <tr> <td>opposite vectors</td><td></td></tr> <tr> <td>parallel vectors</td><td></td></tr> <tr> <td>resultant vectors</td><td></td></tr> <tr> <td>collinear vectors</td><td></td></tr> </table> <p>4.2 Car A is travelling at 110 km/h, and Car B is travelling at 100 km/h.</p> <ol style="list-style-type: none"> <li>Give an example where the magnitude of <math>A - B</math> is equal to 210 km/h.</li> <li>Give an example where the magnitude of <math>A - B</math> is equal to 10 km/h.</li> <li>If A and B are at right angles, what is the magnitude of <math>A - B</math>?</li> </ol>	opposite vectors		parallel vectors		resultant vectors		collinear vectors	
opposite vectors									
parallel vectors									
resultant vectors									
collinear vectors									

**Strand: Space and Shape (3-D Objects and 2-D Shapes)****Students will:**

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

[C] Communication

[PS] Problem Solving

[CN] Connections

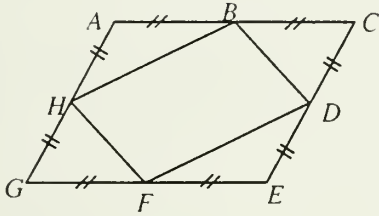
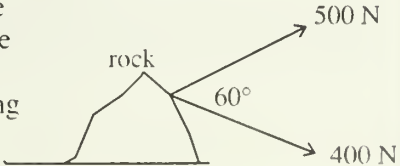
[R] Reasoning

[E] Estimation and

[T] Technology

Mental Mathematics

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
A6–5. Assign meaning to the multiplication of a vector by a scalar. [CN]	<p>5.1 The vector <math>\vec{a}</math> is 40 km/h east. Make a scale drawing of each of the following vectors:</p> <ol style="list-style-type: none"> <li><math>3\vec{a}</math></li> <li><math>7\vec{a}</math></li> <li><math>-3\vec{a}</math></li> <li><math>1.6\vec{a} + 4\vec{a}</math>.</li> </ol> <p>5.2 A price list is represented in Canadian dollars by the vector <math>\vec{p} = (27, 38, 14, 26)</math>. If the Canadian dollar is worth \$0.71 US, what does the vector <math>\vec{q} = 0.71\vec{p}</math> represent?</p>
A6–6. Perform vector additions and subtractions, using triangle or parallelogram methods. [V]	<p>6.1</p>  <p>Using the above diagram of a rhombus <math>ACEG</math>, determine the vector addition of each of the following:</p> <ol style="list-style-type: none"> <li><math>\vec{AH} + \vec{HG}</math></li> <li><math>\vec{GF} + \vec{BC}</math></li> <li><math>\vec{GF} + \vec{CB}</math></li> <li><math>\vec{FD} + \vec{DE}</math>.</li> </ol> <p>6.2 A ski jumper encounters a horizontal friction of 85 N backward, a vertical weight of 750 N downward and an air resistance of 340 N upward. Draw the vector addition of these forces, and use the drawing to find the magnitude and direction of the resultant force.</p>
A6–7. Determine the magnitude and direction of a resultant vector, using triangle, parallelogram or component methods. [CN, T, V]	<p>7.1 A boat is travelling across a river with a forward velocity of 14 m/s, and there is a current of 3 m/s down the river. How fast is the boat travelling?</p> <p>7.2 John and Marie are using two ropes to pull a rock. Draw a vector diagram to estimate the magnitude and direction of the resultant force. Verify the estimate by a calculation, using components.</p> 

**Strand:** Space and Shape (3-D Objects and 2-D Shapes)

*Students will:*

- describe the characteristics of 3-D objects and 2-D shapes, and analyze the relationships among them.

[C] Communication

[CN] Connections

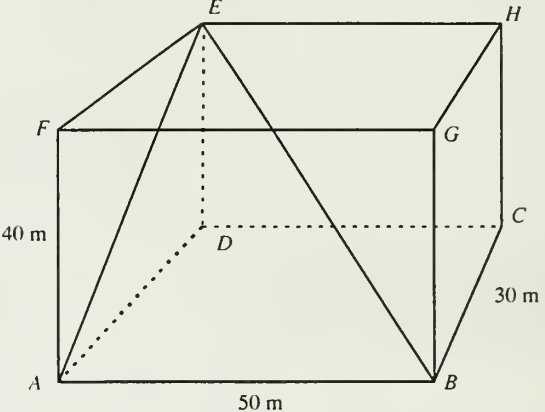
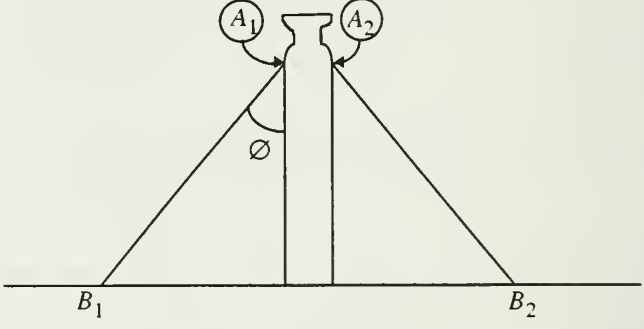
[E] Estimation and  
Mental Mathematics

[PS] Problem Solving

[R] Reasoning

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p>A6–8. Use vector diagrams and trigonometry to analyze and solve practical problems in 3-D and 2-D. [CN, PS, V]</p>	<p>8.1 In the diagram, <math>ED</math> is a vertical transmission tower. <math>EA</math> and <math>EB</math> are two of the guy wires. Use the information in the diagram to calculate the angle between guy wires <math>AE</math> and <math>EB</math>.</p>  <p>8.2 The support cables for a gas plant flare attach at points <math>A_1</math> and <math>A_2</math>. The angle of attachment (<math>\emptyset</math>) is <math>28^\circ</math>. If a horizontal wind from left to right exerts a force of 1200 N at point <math>A_1</math>, what is the force lifting the anchor at point <math>B_1</math>?</p>  <p>8.3 An aircraft flying horizontally on a heading of <math>285^\circ</math> is pushed by a wind from <math>195^\circ</math>. Angles are measured clockwise from north. The indicated air speed of the aircraft is 300 km/h. The wind is constant at 90 km/h. After 1 hour and 15 minutes of flight, what will be the aircraft's change in location?</p> <p>8.4 Model, by drawing a diagram, Jack's jogging route, if he jogs north at 15 km/h for 30 minutes and then turns east and jogs at 12 km/h for 20 minutes. How far has he jogged in total? How far is he from his starting point? In what direction does he need to go to return to the start by the shortest path?</p>



**Strand:** Statistics and Probability (Chance and Uncertainty)

*Students will:*

- use experimental or theoretical probability to represent and solve problems involving uncertainty.

{C} Communication      {PS} Problem Solving  
 {CN} Connections      {R} Reasoning  
 {E} Estimation and      {T} Technology  
 Mental Mathematics      {V} Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]																														
<p><b>General Outcome</b></p> <p>Use normal and binomial probability distributions to solve problems involving uncertainty.</p> <p><b>Specific Outcomes</b></p> <p>C6–1. Find the population standard deviation of a data set or a probability distribution, using technology. [CN, E, T, V]</p>	<p>1.1 Measure the height of each student in a class, and calculate the mean and standard deviation.</p> <p>1.2 A company uses an automated packaging device to produce 50-g bags of Karmel Korn. The machine needs frequent checking to see if it is actually putting 50 g in each bag. The following are the masses, in grams, of thirty bags of Karmel Korn.</p> <table><tr><td>54</td><td>50</td><td>47</td><td>50</td><td>51</td><td>50</td></tr><tr><td>53</td><td>50</td><td>47</td><td>51</td><td>50</td><td>51</td></tr><tr><td>52</td><td>49</td><td>46</td><td>52</td><td>50</td><td>49</td></tr><tr><td>52</td><td>48</td><td>48</td><td>53</td><td>49</td><td>49</td></tr><tr><td>51</td><td>48</td><td>49</td><td>52</td><td>49</td><td>50</td></tr></table> <p>a) Calculate the mean and standard deviation of this data. b) What problems will be encountered, if the standard deviation gets too high?</p> <p>Dottori et al., <i>Foundations of Mathematics 11</i>, p. 391. Adapted with permission.</p>	54	50	47	50	51	50	53	50	47	51	50	51	52	49	46	52	50	49	52	48	48	53	49	49	51	48	49	52	49	50
54	50	47	50	51	50																										
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51	48	49	52	49	50																										
<p>C6–2. Use <math>z</math>-scores and <math>z</math>-score tables to solve problems. [PS, R, T, V]</p>	<p>2.1 The volume of the contents of a soft drink can is normally distributed about a mean of 350 mL, with a standard deviation of 1.5 mL.</p> <p>a) Calculate the <math>z</math>-score for a can with a volume of 355 mL. b) What percentage of production will consist of cans having content volumes between 350 mL and 355 mL? c) What percentage of production will consist of cans having content volumes less than 355 mL? d) If cans containing less than 346 mL must be rejected, how many cans will be expected to be rejected in a run of 50 000?</p>																														



**Strand:** Statistics and Probability (Chance and Uncertainty)

*Students will:*

- use experimental or theoretical probability to represent and solve problems involving uncertainty.

[C] Communication

[CN] Connections

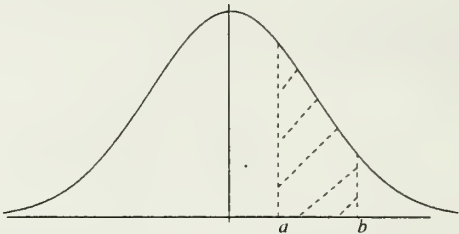
[E] Estimation and  
Mental Mathematics

[PS] Problem Solving

[R] Reasoning

[T] Technology

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>2.2</p>  <p>a) What is the area under this curve?</p> <p>b) If <math>P(a &lt; z &lt; b) = 0.4</math>, what is the area under the curve for the interval <math>a &lt; z &lt; b</math>?</p> <p>c) If <math>P(z &lt; b) = 0.9</math>, calculate <math>P(z &gt; b)</math>, and calculate the value of <math>b</math>.</p> <p>2.3 For entry into the Canadian Armed Forces, the standards for height used to be set at 158 cm to 194 cm for males, and 152 cm to 184 cm for females. Use the concept of <math>z</math>-score to test if these two height standards are equivalent. Assume means of 176 cm and 163 cm and standard deviations of 8 cm and 7 cm respectively.</p> <p>2.4 A sample of 122 people gives a mean body temperature of <math>36.8^{\circ}\text{C}</math>, with a standard deviation of <math>0.35^{\circ}\text{C}</math>. Assuming a normal distribution, find:</p> <p>a) the expected number of people with temperatures above <math>37.0^{\circ}\text{C}</math></p> <p>b) the expected number of people with temperatures below <math>36.0^{\circ}\text{C}</math>.</p> <p>Also, estimate the range of temperatures contained within the sample.</p> <p>2.5 In the general population, the IQ scores of individuals is normally distributed with a mean of 110 and a standard deviation of 10. If a large group of people is tested:</p> <p>a) What proportion of this group is expected to have IQs between 100 and 120?</p> <p>b) What is the probability that an individual in the group has an IQ greater than 120?</p>

**Strand:** Statistics and Probability (Chance and Uncertainty)

*Students will:*

- use experimental or theoretical probability to represent and solve problems involving uncertainty.

[C] Communication [PS] Problem Solving  
 [CN] Connections [R] Reasoning  
 [E] Estimation and [T] Technology  
 Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
C6–3. Use the normal distribution and the normal approximation to the binomial distribution to solve problems involving confidence intervals for large samples. [CN, E, PS]	<p>3.1 The heights of males employed by a manufacturer follow a normal distribution with a mean of 169 cm and a standard deviation of 8 cm.</p> <p>a) Establish a symmetric 95% confidence interval for the average height in a random sample of 36 male employees.</p> <p>b) What happens to the width of the symmetric 95% confidence interval, if the sample size is increased from 36 to 225?</p> <p>3.2 Pollsters estimate that the number of decided voters in favour of a particular bylaw is 64%, and the number opposed is 36%.</p> <p>a) If the sample size is 250, find the expected mean and standard deviation of <i>yes</i> voters.</p> <p>b) Estimate, for this sample, the expected percentage of <i>yes</i> voters, with a symmetric 95% confidence interval used to establish the margin of error.</p> <p>c) If the margin of error for the percentage of <i>yes</i> voters must be less than <math>\pm 1.0\%</math>, what would be the minimum sample size required?</p> <p>3.3 The probability that a car salesperson will complete a sale is 0.10. If the salesperson has 200 customers in the next month, establish a symmetric 95% confidence interval for the number of completed sales for the month.</p>

- use experimental or theoretical probability to represent and solve problems involving uncertainty.

**[E] Estimation and Mental Mathematics**

[V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Solve problems based on the counting of sets, using techniques such as the fundamental counting principle, permutations and combinations.</p> <p><b>Specific Outcomes</b></p> <p>C6-4. Solve pathway problems, interpreting and applying any constraints. [PS, R]</p>	<p>4.1 Given the following “pinball” situation, what is the probability of the ball reaching each of the exits?</p> <div data-bbox="677 852 1247 1279" style="text-align: center;"> </div>
<p>C6-5. Use the fundamental counting principle to determine the number of different ways to perform multistep operations. [PS, R]</p>	<p>What assumptions are made in the solution?</p> <p>5.1 Joe has three different shirts, two different pairs of pants and five different pairs of shoes. List all possible outfits in such a way as to ensure that all have been counted and none have been counted twice. How many possible outfits are there? Use the fundamental counting principle to determine the number of outfits there should be. Do your answers match?</p> <p>5.2 An airline pilot reported that in seven days she spent one day in Winnipeg, one day in Regina, two days in Edmonton and three days in Yellowknife. How many different itineraries are possible? What difference would it make if the first day and the last day had to be spent in Yellowknife?</p>

**Strand:** Statistics and Probability (Chance and Uncertainty)

*Students will:*

- use experimental or theoretical probability to represent and solve problems involving uncertainty.

[C] Communication [PS] Problem Solving  
 [CN] Connections [R] Reasoning  
 [E] Estimation and [T] Technology  
 Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
<p><b>General Outcome</b></p> <p>Model the probability of a compound event, and solve problems based on the combining of simpler probabilities.</p> <p><b>Specific Outcomes</b></p> <p>C6–6. Construct a sample space for two or three events. [PS, R, V]</p> <p>C6–7. Classify events as independent or dependent. [C]</p> <p>C6–8. Solve problems, using the probabilities of mutually exclusive and complementary events. [CN, PS, R]</p>	<p>6.1 List the sample space for rolling a 6-sided die and flipping a coin.</p> <p>6.2 Draw or list the sample space for the following situation. A bus is scheduled to arrive at a train station at any time between 07:05 and 07:15 inclusive. A train is scheduled to arrive between 07:11 and 07:17 inclusive. The arrival of a bus at 07:06 and a train at 07:14 can be represented by the point (6, 14). Times are expressed in whole minutes.</p> <p>a) How many points are there in this sample space?</p> <p>b) How many points have the bus and the train arriving at the same time?</p> <p>c) How many points have the bus arriving after the train?</p> <p>d) What is the probability of the bus arriving after the train?</p> <p>7.1 Classify the following events as independent or dependent:</p> <p>a) tossing a head in a coin toss and rolling a 6 on a die</p> <p>b) drawing an ace for the first card and another ace for the second, if the experiment is carried out without replacement</p> <p>c) drawing a king for the first card and a queen for the second, if the experiment is carried out with replacement.</p> <p>7.2 Sixty per cent of young drivers take driver training, and 25% of young drivers have an accident in their first year of driving. Statistics show that 10% of those who do take driver training have an accident in their first year. Are taking driver training and having an accident in the first year independent events?</p> <p>8.1 If the probability of winning a game is <math>\frac{1}{31}</math>, what is the probability of losing the game?</p>

**Strand:** Statistics and Probability (Chance and Uncertainty)

*Students will:*

- use experimental or theoretical probability to represent and solve problems involving uncertainty.

[C] Communication [PS] Problem Solving  
[CN] Connections [R] Reasoning  
[E] Estimation and [T] Technology  
Mental Mathematics [V] Visualization

General and Specific Outcomes	Illustrative Examples [Discretionary]
	<p>8.2 A shootout consists of teams A and B taking alternate shots on goal. The first team to score wins. Team A has a probability of 0.3 of scoring with any one shot. Team B has a probability of 0.4 of scoring with any one shot.</p> <p>a) If Team A shoots first, what is the probability of Team B winning on its first shot?</p> <p>b) If Team A shoots first, what is the probability of Team A winning on its third shot?</p>



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